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INTRA-THORACIC EFFUSION.

NORMAN PORRITT.

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THE OPERATIVE TREATMENT OF
INTRA-THORACIC EFFUSION.

THE
OPERATIVE TREATMENT
OF
INTRA-THORACIC EFFUSION,

BY

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BEING THE ESSAY TO WHICH THE MEDICAL SOCIETY OF
LONDON AWARDED THE FOTHERGILLIAN
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TO
THOMAS SCATTERGOOD, Esq.,
SURGEON TO THE WOMEN AND CHILDREN'S HOSPITAL,
AND
LECTURER ON FORENSIC MEDICINE AND TOXICOLOGY AT
THE SCHOOL OF MEDICINE, LEEDS,
THIS LITTLE VOLUME IS DEDICATED,
AS A TOKEN OF ESTEEM FOR HIS CHARACTER AND
ADMIRATION FOR HIS PROFESSIONAL KNOWLEDGE
AND SKILL,
NO LESS THAN IN GRATEFUL REMEMBRANCE OF MANY
ACTS OF KINDNESS RECEIVED BY
THE AUTHOR.

PREFACE.

No book is deemed complete without a preface, and no preface can be considered orthodox without an apology. By transposing the concluding sentences of our essay, we secure the groundwork of an orthodox preface, and at the same time, advance the work a step towards the goal of completeness, from which it is so far distant. "Our essay falls short of our anticipated ideal, and, on perusing it, we notice deficiencies and superfluities. For these we ask indulgence, as they are unavoidable in the case of one writing, as it were, against time, amid the duties of professional work and the calls of social engagements." With the exception of the above transposition, and slight modification of the sections relating to pneumo-thorax and mediastinal effusion, the Essay is presented to the reader, with some unimportant verbal alterations, in the same state as when it gained the unanimous award of the Adjudicating Committee of the Medical Society of London.

It now remains for me to offer my thanks to the Council of the Medical Society of London, for permission to publish the Essay; to Professor Marshall, for the use of the drawing on p. 9; to Drs. Clifford Allbutt, Eddison, Barrs, Silk, Kilner Clarke, and Hanson; and to Messrs. Jessop, Scattergood, and F. R.

Dawson, for permission to mention or publish notes of cases ; to Drs. A. H. Jacob, J. W. Moore, and J. F. B. Quinlan, of Dublin ; Mr. Chas. H. Wade, London ; Mr. Hugh Kershaw, of the Leeds Dispensary ; and my friend, Mr. J. N. Richardson, late Senior House-Surgeon, Infirmary, Huddersfield, for reference to cases and information on matters of detail.

Lastly, I desire to acknowledge my indebtedness, not only in the preparation of this Essay, but since the commencement of my career as a medical student, to Mr. Isaac Pitman, by means of whose admirable, yet simple, system of phonetic shorthand, I have been spared much tedious clerical work, have economised my time, and put myself in permanent possession of valuable observations and facts, many of which would otherwise have been irrevocably lost. If intending students were aware of the assistance this useful art can render during their career, I venture to think few would enter a medical school uninitiated into its principles ; and if “those in authority over us” had an adequate conception of its advantages, it would be placed among the optional subjects of the preliminary examination, where it would prove of infinitely more value than the superficial smattering of knowledge which is demanded in the case of some of the optional subjects.

NEW NORTH ROAD,

HUDDERSFIELD,

1ST SEPTEMBER, 1883.

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ERRATA.

At page 2 line 25 *for* physicial *read* physical.

„ 9 „ 3 *for* auterior *read* anterior.

„ 19 „ 3 *for* understood it by *read* understood
by it.

„ 24 „ 13 *for* confidendtly *read* confidently.

„ 30 „ 11 *for* accurence *read* occurrence.

„ 44 „ 19 *for* oblect *read* object.

„ 55 „ 4 *for* accumulaton *read* accumulation.

„ 65 „ 17 *for* dieuretic *read* diuretic.

„ 72 „ 14 *for* or inflammatory *read* non-inflam-
matory.

„ 91 „ 14 *for* reual *read* renal.

„ 111 „ 35 *for* inffuence *read* influence.

„ 113 „ 12 *for* cold effusion *read* cold affusion.

„ 113 „ 12 *for* pnemogastric *read* pneumogastric.

„ 114 „ 23 *for* inspiration *read* aspiration.

„ 195 „ 7 *for* diagnosis of the withdrawal *read*
diagnosis and the withdrawal.

„ 298 „ 31 *for* constipulation *read* constipation.

THE OPERATIVE TREATMENT OF INTRA- THORACIC EFFUSION.

INTRODUCTORY.

THE leaders of the Medical Profession divide themselves into Physicians and Surgeons; the former professing to cure diseases by drugs or other means not involving operative procedures, while the latter aim at success by the appropriate application of manipulative tact and ability or the skilful use of instruments.

Such a division, however, though convenient is artificial. The Physician must often deal with cases where surgical principles cannot fail to aid his diagnosis or be included in his treatment; and the Surgeon must attribute the successful termination of a large proportion of his cases to his acquaintance with duties strictly within the scope of the Physician; for the stethoscope is to him as indispensable as the catheter to the Physician. Indeed, it is often difficult to determine when a case becomes purely surgical or exclusively medical, or to indicate that point in its history and progress where the legitimate functions of the Physician end, or the peculiar duties of the Surgeon begin.

In the case of many affections the distinction is plain and evident. The removal of Tumours, the restoration of bones to the normal position, or the amputation of limbs are properly included in the Surgeon's duties; and, on the other hand, the tasks of leading fevers to a natural termination, of combatting the influence of poisons, or of rectifying disorders of digestion are fitly allotted to the Physician.

It is, however, not difficult to cite cases where the duties of each cannot be so accurately and clearly

defined; where, indeed, it is incumbent upon the Physician to overstep the boundary which separates his work from that of the Surgeon, or for the Surgeon to traverse fields which the Physician considers his own. To whom can be assigned the treatment of lardaceous disease of the kidneys, or other lung disease, the result of continued suppuration? Within whose domain does the performance of tracheotomy for croup or laryngitis come? Or which is entitled to an exclusive right to treat struma, hydrophobia, glanders, erysipelas, aneurism, or syphilis? And lastly, shall we grant to the Physician or to the Surgeon the privilege of treating cases of Intra-thoracic Effusion?

The class of diseases which the term Intra-thoracic Effusion comprises finds a place upon that debateable ground, where Physician and Surgeon must meet, and working in harmony, mutually throw their individual and combined efforts into combat with the disease which is perhaps threatening the life of the patient. Arduous duties will devolve upon the Physician and heavy responsibilities rest upon the Surgeon: each will find opportunity for the display of his skill and knowledge, though neither alone is competent to have charge of every case of this description. In no other class of cases does methodical physical examination of the chest prove of greater value, and never is surgical aid, invoked at the proper moment, more beneficial: it is in these cases that refinements in diagnosis, that perceptive ability and intelligent appreciation of delicate and obscure sounds stand out prominently; whilst it is in these cases that the Surgeon's presence of mind and readiness of resource will often be put to the test. He, therefore, who aspires to deal with these cases must have been trained in that part of his duties which would fall to the lot of the pure Physician, as well as in the science and practice of the Surgeon's art and skill.

And one cannot but feel on commencing an essay on "The Operative Treatment of Intra-thoracic Effusion," that it will be difficult, if not impossible, to complete it without allusion to medical facts and treatment. The subject itself is a wide one, and medical facts cannot

be disregarded ; but the reader may be assured that only where they bear directly on that portion of the subject under consideration will they be introduced. On the other hand the medical treatment *per se* will not be discussed ; but if conjoined with surgical treatment, allusion will be made to it.

Questions of diagnosis cannot be altogether advantageously omitted, although the remarks under this head will be as brief as possible, and made only where the importance of the subject seems to demand.

I thus endeavour to disclose my reason for approaching my subject in this round-about fashion. It shall now be my earnest endeavour to present a succinct account of my views and opinions, without superfluous digression, or the introduction of irrelevant matter, and when the competing essays have been read, I trust that he who deserves may receive the prize.

“Palmam qui meruit Ferat.”

CHAPTER I.

INTRA-THORACIC EFFUSION.

By the term *Intra-thoracic Effusion* we denote that class of diseases or form of accident characterized by the accumulation or deposition of liquid or gaseous matter—mixed or alone—in one or more of the cavities within the thorax. The cavities in which effused material has been found are the following :—

1. THE MEDIASTINA.
2. THE PERICARDIUM.
3. THE PLEURÆ.

The nature of the effusion varies, and the products here mentioned have been met with :—

1. Serum.
2. Pus.
3. Air; either alone or mingled with serous, purulent or sanguineous fluids.
4. Blood.
5. The fluid of hydatid cysts.
6. Intestinal contents, with abdominal viscera.
7. Contents of the stomach.

It is the pleural cavity that is most frequently implicated, and the surgical means and operative measures of service in restoring it to the normal condition will, therefore, first receive attention; the treatment necessary when effusion takes place into the pericardium and mediastina being reserved for consideration afterwards. Preliminary allusion to certain anatomical and physiological points respecting the Thorax, will, however, be desirable.

THE THORAX.

The Thorax is a barrel-shaped conical cavity, containing the larger organs of respiration and circulation.

An imaginary plane drawn perpendicularly between the spine and sternum will divide it into halves, which, not quite symmetrical, may, for practical purposes, be considered so ; and on the right hand side of this plane is the lung of that side, on the left, the heart, pericardium, and other lung. Each lung is adjacent to the chest-wall, but is separated from immediate contact with it by a closed sac—the pleura—which in the healthy individual contains liquid not more than sufficient to moisten its opposing surfaces and favour their gliding movements upon each other. There is a pleura for each lung, the pulmonary or visceral reflection of which converge anteriorly and posteriorly, thence pass to form the covering of the ribs and the intercostal spaces as the parietal layer, and in doing so leave a triangular space between the walls of the chest and their outer surface. These spaces are termed mediastina, anterior and posterior respectively. Like the lungs the heart has a serous investment which is reflected over the contiguous pleura, and the parietal layer formed, and this—also a closed sac—is named the pericardium. Within the Thorax are seven cavities, viz :—

The cavity on each side between the layers of the pleura or pleural cavity.

The cavity on each side formed by the inner surface of the visceral layer of the pleura, which cavity is filled by the lung.

The mediastina posterior and anterior.

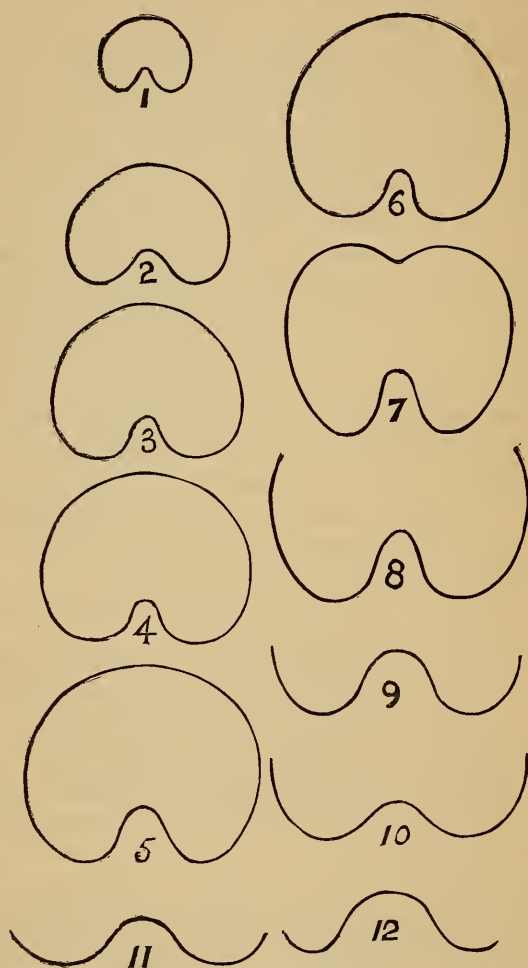
The cavity enclosing the heart—the pericardial ; sometimes denominated the middle mediastinum.*

The framework of the Thorax is composed of bone, and strong, but resilient cartilage ; the osseous portion comprising the vertebræ, ribs, and sternum ; the two latter being separated from each other by the cartilaginous portion—named costal cartilages. Arising from the posterior border of contiguous vertebræ, the

* There is also a superior mediastinum which, however, does not bear relation to operations on the chest.

ribs pass for a short distance outwards and slightly backwards, then make an abrupt turn to a course almost directly forwards, and at length are directed

FIGURE 1.



Sections of a cast of the Thorax showing the space encompassed by each pair of ribs respectively. (After Hutchinson.)

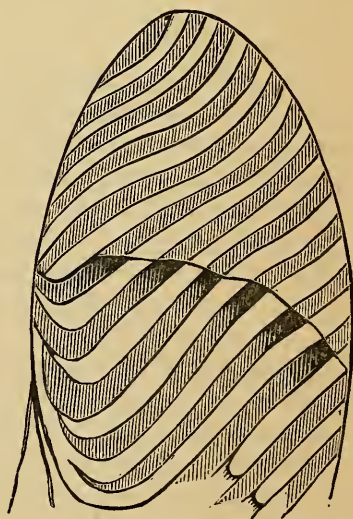
inwards and forwards to the costal cartilages. Between the inner surface of the posterior extremity of each rib, there is therefore a cavity, which the projection of the bodies of the vertebræ makes larger. This cavity

persists through the length of the Thorax, and is deserving of notice, as the lung when compressed is usually pushed into it. The shape and relative size of this *cul de sac* may be seen from the following drawings of casts of the Thorax at different heights. (See Fig 1.) In the healthy subject the lobes of the lungs spreading out fill the space thus left; and in abnormal conditions, whether from pressure upon the surface of the lung by extraneous matter effused within the pleura, from cirrhotic disease, or the supervention of the condition known as *atelectasis*, the compressed or collapsed lung, if unadherent to the remainder of the chest-wall, generally reaches the inner or spinal side of this fossa. This region, therefore, should be carefully examined before the chest is perforated by an instrument.

The Thorax is separated from the abdomen by a musculo-tendinous structure, the *diaphragm*, whose convex upper surface forms the floor of the Thorax. Arising from the whole of the circumference of the Thorax it forms its lower limit externally, but, from this boundary, the fibres ascend from every point to the tendinous centre reaching on forced expiration on the right side as high as the level of the 4th cartilage, on the left about an inch lower.

In the dead subject its highest point is the upper border of the 5th costal cartilage on the right side, and the upper border of the 6th on the left. During inspiration it descends one or two inches, and its slope would be represented by a line drawn from the ensiform cartilage to the 10th rib posteriorly. The accompanying drawing of a cast of the Thorax at death will convey to the reader these figures more clearly and demonstrate that but a comparatively small portion of

FIGURE 2.



Thorax at death. (After Hutchinson)

the inner surface of the ribs is within the Thoracic cavity, as well as suggest the dangers of operating through an intercostal space at or near the diaphragmatic level.

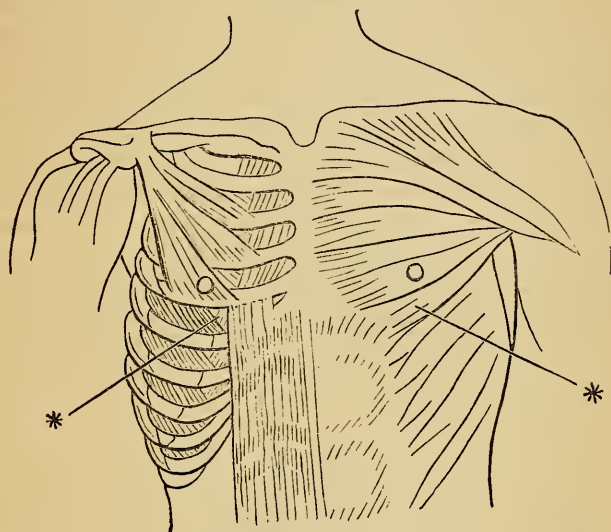
The ribs arising at some distance from each other a vacancy in the chest wall intervenes between them, which is filled up by the intercostal muscles. These are attached to the borders of the ribs, and arranged in two sets external and internal, and it is necessary to bear in mind that the external reach anteriorly only as far as the junction of the ribs and costal cartilages. The intercostal spaces are in the adult about $\frac{3}{4}$ of an inch in breadth, but are wider in front than at the sides and back, and the direction of their long axes posteriorly is much more oblique behind than in front. Each interspace can be widened by endeavouring to touch with the hand the opposite shoulder over the head; and, in the adult, in the axillary line the 6th interspace was made $\frac{1}{4}$ of an inch wider, whilst in a child nine years of age the breadth of the interspace below the angle of the scapula was increased from $\frac{3}{8}$ to $\frac{1}{2}$ an inch. This circumstance is of considerable value in facilitating the entrance of instruments between the ribs, although if internal pressure from disease be considerable, widening of the interspaces may exist.

The effect of disease, however, may approximate the ribs, as occurs in spinal curvature and diseases attended with shrinking and contraction of the lung. In the former the narrowing of the spaces and consequent diminution in the size of the chest is the result of Extra-thoracic disease, in the latter of Intra-thoracic. We shall see that Intra-thoracic Effusion, operated upon at a late period of its existence, is a cause of contraction of the chest. Expiration causes narrowing, and inspiration widening of the intercostal spaces.

The protective function of the Thoracic skeleton is augmented by the disposition of various pairs of muscles, which, although they are not, like the intercostals, respiratory or Thoracic muscles, claim notice on account of the obstacle they offer in an

operation upon the chest wall. A recent writer* has drawn attention to the muscular arrangement of that part of the anterior aspect of the Thorax least covered by muscles. I reproduce the description in his words, and insert the diagram by which he represents it pictorially.

FIGURE 3.



“As to the 5th interspace the arrangement in ordinary cases of the adjacent muscles is as follows:—The external intercostal muscle terminates, as usual, near the costal cartilages, to the outer side of the spot in question, at and beyond which towards the sternum only a thin fascia covers the internal intercostal muscle; the lesser pectoral which ascends from the 3rd rib, is, of course, above the 5th space; the outer border of the rectus muscle of the abdomen passes up to the 5th cartilage and limits the spot on its inner side; superficially to these parts, the thick bundle of the great pectoral, which springs from the 6th rib crosses over this spot although a few thin

* Professor Marshall on Surgical Treatment of Diseases of Chest Wall. *Lancet*, March 4, 1882, p. 337.

fibres which arise from the 6th rib, and those which blend with the external oblique muscle of the abdomen, or with the sheath of the rectus may pass over it; or the slender fasciculus of the muscle itself may cover it. Here, in fact, is a part of the chest wall below the 5th rib and beneath the nipple relatively unprotected by adjacent muscles. The internal intercostal muscle, the thin intercostal fascia and the weakest portion of the great pectoral and the external oblique, together with the common fascia are, besides the skin, the only coverings of the pleural sac in this situation." Professor Marshall claims that spontaneous perforation of an empyema generally takes place at this spot.

Passing next to the posterior aspect of the chest we shall discover a portion of the surface with almost as thin a muscular covering as that of the 5th interspace anteriorly. I allude to the 8th and 9th interspaces, a little external to the inferior angle of the scapula.

FIGURE 4.



On reflecting the skin over the scapula, the converging fibres of the latissimus dorsi are found crossing its lower extremity, and covering the structures below it. These, on division and reflection of the latissimus are

seen to be the last four ribs with the interspaces above them, no other muscle concealing the latter at this point. The lower edge of the Rhomboideus major passes upwards to the upper dorsal spine, the serratus magnus is the external, the vertebral aponeurosis enclosing the large and deep muscles of the back, the internal boundary, while the serratus posticus inferior does not reach higher than the lower border of the 9th rib, and covers only a diminutive area of the 9th, 10th, and 11th interspaces, close to the outer margin of the erector spinæ. If the latissimus dorsi were absent the external intercostal muscles and fascia would present on reflecting the skin; nothing but they and the internal intercostals intervening between the pleura.

MOBILITY OF SCAPULA.

Now, it is possible to alter considerably the relations of the latissimus dorsi to the parts beneath it, by artificially changing the position of the lower angle of the scapula, any movement of which drags or pushes the latissimus dorsi with it. The mobility of the scapula is very considerable, and it is possible in a thin subject, by using the arm of the same side as a lever, to force it either close to the spinous processes of the vertebræ, or transfer it to such a position that its angle projects anteriorly beyond the middle of the axilla. By putting the hand over the head towards the opposite shoulder, the scapula rotates on an imaginary axis, passing through its neck or thereabouts, and the lower angle is propelled from the back towards the front of the chest, in a *downward direction*. Although apparently the raised arm is dragging the shoulder with it, it will be found that each effort to touch the opposite shoulder coincides with descent of the angle of the scapula. In the case of a child nine years of age, where the scapula reached the lower border of the seventh rib, it descended to the upper border of the eighth rib, one inch more externally, when the arm was raised above the head. The angle of the scapula of a youth 15 years of age was on a level with the eighth dorsal spine; by putting the arm over the head, it passed obliquely outwards

and downwards for a distance of $2\frac{5}{8}$ inches, nearly to the level of the tenth dorsal spine, its position being perpendicularly one inch below the level of its former one. In another youth of the same age the angle traversed $2\frac{5}{8}$ inches downwards and outwards; in this case, however, it descended two inches. In a man aged 28 years, when the arm hung easily by the side, the angle of the scapula was four inches from the spine; but when the arm was placed over the head the distance was $6\frac{1}{4}$ inches, and $1\frac{1}{4}$ inches lower. In a man aged 61 years, the angle of the scapula with the arm at rest, was 6 inches from the spine; but when the arm was raised over the head, it had a position $6\frac{3}{4}$ inches distant, and one inch lower.

By moving the angle of the scapula outwards the fibres of the latissimus dorsi, which are more aponeurotic, as they near the spine, are put upon the stretch, the thick bundle investing the lower end of the scapula is forced into the axilla, and the flat layer of thin fibres arising near the spine takes its place, so that the intercostal spaces, which were before thickly covered are left much barer, and more easily perceptible. And the angle of the scapula in its descent, changes the direction of the upper margin of the muscle, from one slightly upwards to one markedly downwards, and exposes a portion of the external intercostal muscle in the 8th space. To appreciate this it is only necessary to place the patient's arm above his head, examine the interspaces then revealed, and with the finger in position allow the arm to return slowly to the side, when a soft prominence on the outer side of the finger—which disappears when the finger is removed—will indicate the fibres of the muscle resuming their former position. The tension and flaccidity of the muscles of the back included in the first and second layers are determined by the position of the arm, and it is a matter for admiration, if not of astonishment, that they are at one time tightly spread out, at another wrinkled and loose; and a ready means is provided for exposing the intercostal spaces before operation, at a point often selected for entering the chest cavity.

IN ORDER TO FIND THE 8TH INTERCOSTAL SPACE it is necessary to mark on the skin the position of the angle of the scapula when the arm is by the side and also when the arm is raised above the head ; one inch below the middle of the line drawn between these two points will be found the desired spot. I have tested the accuracy of this observation many times and in persons of all ages, and have, not excluding children, with few exceptions, found it correct. It would appear that stature and age influence the width of the interspaces and size of the bones as well as the extent of the scapula's movement. The 8th intercostal space at this point is on a level with the lower border of the 4th interspace in the nipple line, or as high as the diaphragm reaches in forced expiration.

The anterior divisions of the intercostal arteries supply the intercostal spaces with blood ; each division sub-dividing, the longer branch to run along the groove at the lower margin of each rib, the smaller division along the upper border of the rib below. The internal mammary artery runs parallel with and about three lines from the margin of the sternum, on the inner surface of the anterior chest wall.

RESPIRATION consists of expansion of the chest and its subsequent recoil, and is a function which, though partly under voluntary control, is not entirely so, a circumstance due to the fact that one portion of the act arises from properties inherent to the tissues of the organs taking part in it. Inspiration is a result of the action of certain muscles, but normal expiration is the effect of the elasticity of the thoracic structures acting without the aid of muscular force. The elasticity of the lungs is demonstrated by admitting air in a certain manner into the pleura of a dead animal through a free opening, when collapse of the lungs takes place if the air passages be unobstructed ; but if, before opening the pleural cavity, a ligature be placed round the trachea so as to effectually prevent egress of air, no collapse will occur, and the lungs will remain distended so long as the ligature remains in situ, though they at once collapse if it be removed. This experiment,

besides indicating the contractile property of lung tissue unaided by muscular effort, points out that the pressure of the air within the pulmonary alveoli keeps the whole lung in a state of constant tension, and that if the pressure on each side be equalised, collapse is favoured or rendered imminent. This consideration must be carefully borne in mind. Further, inspiration augments the tension of the lung tissue beyond the normal range, and after it, the lung by its own properties returns to its state of normal tension. Thus, if pressure outside the lung, from whatever cause, compress it unduly, the tendency of the lung tissue is not to return to the state of expansion, but to that of collapse, or, as it is called, "carnification." The lung may be compared to a solid indiarubber cricket-ball, which has been permeated and distended by air, and which, when the air is withdrawn, will return to its former size. The foetal lung that has never breathed is solid and sinks in water, and the adult lung, surrounded by an equal atmospheric pressure will approach to that foetal condition.

It is of importance to note that *the power of expiration is greater than that of inspiration*. Hutchinson* in an article, which all interested in the physiology of respiration, or about to take charge of cases of Intra-thoracic Disease should peruse, relates the results of his examination of the power of inspiration and expiration in 1500 men. "We connected a column of Mercury with the index on a dial plate which represented the inches and tenths of inches of Mercury lifted. A tube was adapted through the nostrils through which the inspiratory and expiratory effort was made. By the former the index was moved in one direction, and by the latter in the contrary direction; each half of the dial plate representing respectively, inspiratory and expiratory power, with expressive words attached as follows :—

* J. Hutchinson, M.D., Art. "Thorax," Cyclopædia of Anatomy and Physiology.

Power of inspiratory muscles.	Power of expiratory muscles.	
1-5....Weak.....	2-0 inches of Mercury raised.	
2-0....Ordinary	2-5	do
2-5....Strong	3-5	do
3-5....Very strong	4-5	do
4-5....Remarkable	5-8	do
5-5....Very remarkable ..	7-0	do
6-0....Extraordinary	8-5	do
7-0....Very extraordinary	10-0	do

Thus measured the power capable of being exerted during expiration is one third greater than during inspiration. Where the expiratory and inspiratory power are the same, disease is indicated." The knowledge of these facts compels me to reiterate my statement regarding the natural tendency of the lung to collapse, in order that the reader may appreciate its practical value when I discuss the operative treatment of those conditions where the lung is squeezed and pressed upon.

THE FISSURES OF THE LUNGS divide them into lobes, of which there are three on the right and two on left side. The fissures almost completely divide the lungs, and can be best traced from the posterior surface, where they commence, in the root of the lung, at about the level of the lower part of the second intercostal space, whence they take a direction almost corresponding to that of the ribs, and their anterior aspect comes into relation with about the fourth rib. A needle, therefore, thrust into the posterior or latero-posterior portion of the chest, below the fourth rib, passes directly to the surface, and penetrates the substance of the lower pulmonary lobe, and we desire to point out the greater distance an incision made behind in the eighth interspace is from the free edge of one of the pulmonary lobes, than one made in the fifth interspace anteriorly, where its proximity is much closer, not only to the pulmonary lobes, but also to the inferior border of the lung. The fissures of the lung on each side are two, and although the right lung has three lobes, the supernumerary one is the result of a short upward branch from the main fissure, and does not have any bearing upon the operative treatment of the intra-thoracic effusion.

CHAPTER II.

THE OPERATIVE TREATMENT OF INTRA-THORACIC EFFUSION.

“There is no doubt that the imagination often influences us largely in our choice of operations, and that we readily undertake some operations, which are desperately dangerous, with light hearts, because there is nothing alarming in them to the imagination, while others which do exercise some potent spell over the imagination are really harmless enough and may be undertaken almost without risk.”—CLIFFORD ALLBUTT.*

That the above extract from the writings of one who has done much to render popular and demonstrate the safety and advantages of judiciously undertaken operations upon the chest, is true, none will doubt. But, on the other hand, it cannot be denied that advancing knowledge and increasing experience are every day laying the ghosts which a ready imagination has no difficulty in raising. It is not fifty years since the abdomen was regarded as a sacred cavity, whose interior was to be seen only on the post mortem table; but improved methods united to great care, have enabled operators to cope with the dangers of abdominal section in a very successful manner. The chest, although the repository of the heart and lungs, organs essential to the life of the individual, has scarcely, as regards surgical operation, been the object of the same amount of superstitious dread as formerly protected the entirety of the abdominal cavity. But, nevertheless, the history of operations upon the chest wall, proves that they never became popular and universal. From the time of Hippocrates, who was a consistent advocate of thoracentesis, the estimate of operations for the relief of Intra-thoracic Effusion has fluctuated and varied,

* On Thoracentesis. Practitioner, vol. 2, for 1872, p. 77.

they at one time being practised and recommended by many Physicians and Surgeons, at another period being consigned to the limbo of uselessness and neglect. And it is worthy of note, that the latest "improvement" of one of the operations is but a modification of the old Hippocratican plan, and comprises the removal of a portion of rib, instead of piercing it *in situ*. There are few at the present day, and they belong almost entirely to the "old school" of practitioners, who will deny the utility of paracentesis thoracis, while others—chiefly young enthusiasts—are prepared to operate upon every case of intra-thoracic effusion which comes before them. Let us endeavour to stimulate the apathy of the one and properly direct the zeal of the other, whilst I, copying the example of the judge, who in his charge directs the jury to cast out from their minds preconceived opinions, the result of hearsay or imagination, beg that the reader will permit neither imaginary fears nor sanguine (but ill-founded) expectations to influence his judgment.

When abdominal surgery was in its infancy, when ovariectomy, and the operations to which its successful performance has led, were unheard of, or mentioned only to be denounced, it does not appear that abdominal paracentesis was unpractised. It is no part of my duty here to trace the rise or prove the acceptance of paracentesis abdominis as a legitimate procedure; but I wish to point out the inconsistency of those of our predecessors, who, while they were not afraid to pierce the abdomen and let out pent up fluid, would not dare to evacuate a pleuritic accumulation. The latter operation can be as safely performed as the former. In cases requiring it the lung is nearly always pushed by the fluid from reach of the trocar, and should an adhesion confine it to the costal parietes, the dangerous spot can be discovered and avoided. There is no bladder to penetrate, while the fear of syncope, though present, is much less formidable. Lastly, the unyielding thoracic wall is much less likely to permit injury of the contained viscera from the employment of force in piercing than the soft distensible abdomen.

Indeed, all considerations, both anatomical and practical, included with the results of recent experience, show that operations on the thoracic parietes into the pleural cavity are as safe as those upon the abdominal. In order to explain the frequent performance of abdominal, and the avoidance of thoracic paracentesis, we must fall back upon the quotation at the head of this section, as well as recollect that our forefathers, by drugs and other measures not involving paracentesis, not infrequently procured absorption of fluid in a certain number of cases of pleural effusion. "Therefore," argued they, "as some of our cases recover by the drug treatment, all if they can get better will do so; and if our purgings, bleedings, blisterings, salivations, and sweatings cannot bring the patients round, no operation can." Thus they tapped the abdomen for affections, which it was beyond the power of their drugs to cure; but were content to leave untouched those accumulations within the chest, which, at the present day, timely surgical interference permanently cures much more frequently than the abdominal affection. And we shall have to enquire the value of the treatment of intra-thoracic effusion by drugs alone, by operations alone, and by the two combined.

VARIETIES OF OPERATIONS.

The operations for Intra-thoracic Effusion, are conveniently divided into two classes, as has been done by the most recent writer concerning them;* they are:—

1. The close method of operating.
2. The open method of operating.

The first class of operations might be aptly denominated *subcutaneous*. The operation for the evacuation of Intra-thoracic Effusion is technically termed paracentesis thoracis; that for pericardial effusion, paracentesis pericardii. In perusing descriptions of the operation I have been struck by the loose, indefinite,

*Marshall, *Lancet*, vol. 1, 1882.

and, to me, inaccurate manner in which this term *paracentesis thoracis* is used.

For my own part I have understood it by the tapping of the chest by the close method, but many in relating their cases apply the term to the operation of incision of the chest with the production of a permanent opening. I surmise that no such term as *paracentesis abdominis* would be applied to a cutting operation undertaken for the evacuation of pus within the abdomen. We should then read of incision of the abdomen, or opening of the abdominal cavity, and it would contribute much to the advancement of "chest wall surgery" as well as to the clearness and succinctness of the reports of cases, if writers applied the term *paracentesis thoracis* to the close operation only, *e.g.*, tapping, aspiration; and when speaking of the more important open treatment stated exactly its nature. In the following pages the term will be limited to the "close" method of operating, and the modern introduction "*thora-centesis*" will be used to denote the open operation.

THE OPERATION OF PARACENTESIS THORACIS.

As already stated this operation consists in the tapping or aspiration of the chest; in the former, the fluid to be evacuated flows out by the action of gravity and the siphon action of a tube; in the latter, it is drawn forcibly into the vacuum of an aspirator bottle.

Having by a careful and thorough physical examination satisfied ourselves that the chest contains fluid, and having converted that opinion into a certainty by drawing off with a small exhausting syringe a sample of the effusion, having ascertained that there is no adhesion of the lung at or adjacent to the point selected for operation, and having made sure that the integument of the patient, the hands of all concerned in the operation and all necessary instruments are surgically clean and the latter in good working order, we direct the patient to come close to the edge of that side of the bed corresponding to the affected side of the chest. The patient may be either in a sitting or lying position, and

the latter, by enabling greater extension of the chest wall, with consequent widening of the intercostal spaces, to be made, is preferable; if the former be adopted it will be advisable to direct the nurse to support the patient on the opposite side to minimise any flinching the momentary pain of the puncture may produce. Presuming that the patient is lying down, he turns partially upon the sound side, and that point in the 7th intercostal space, if the right, and in the 8th space if the left chest be tapped, least covered by muscles is marked on the skin by a copying ink pencil. (See page 13.) The skin is then anointed freely with carbolic oil, the arm held over the head, and a trocar and canula, also dipped in carbolic oil, bearing a long india-rubber tube, are pushed boldly through the interspace into the pleural cavity. The operator being convinced, by the sensation conveyed to the hand, that the trocar has entered the cavity of the chest, withdraws it, and looks for the expected fluid in the dish of 5 per cent. carbolic solution, into which the end of the india-rubber tube has been placed. The flow of the fluid being satisfactory the patient may be left in charge of a trustworthy nurse. When the desirable quantity of fluid has been withdrawn, the canula, by a steady but vigorous pull, is removed.

INSTRUMENTS

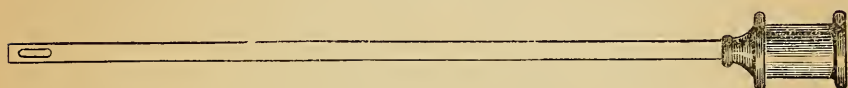
Such are the essential details of the operation of tapping the chest, for which many ingenious and complicated instruments have been invented; of these it may be said as truly as of the different proposals for treating fractures of the clavicle and patella, and hæmorrhage from the intercostal arteries, that their numerical strength is but the indication of their individual incapacity. It is a cause for congratulation that, although these numerous appliances may gratify the vanity of their inventors, a simple and efficient apparatus is all that is required.

A piece of indiarubber tubing, about $\frac{3}{16}$ of an inch bore, and long enough to reach from the patient's chest to the floor, is tied very firmly and securely to the

end of an open canula, not less than three inches long, and of the calibre shown in the accompanying drawing, which represents one of the canulas of Dieufaloy's aspirator, than which none answers our purpose better.

The Trocar is thrust through the tubing close to the canula, which it enters, and the instrument is ready for use.

FIGURE 5.



Canula for Paracentesis, shown slightly enlarged in calibre.

All the good points of the more complicated contrivances can be secured by the simple appliance I recommend, which, besides being perfectly air-tight, can be made thoroughly a-septic. As long as the trocar fills the canula, no air can possibly traverse the instrument, and on pressing the point of the trocar through the end of the canula, a portion of the india-rubber tubing will effectually occlude its entrance. After the cavity of the chest has been entered, the fluid rushes to fill the vacuum left in the canula by the withdrawal of the trocar, and so soon as the point of the instrument quits the tube, so soon does the inherent elasticity efface the site of the puncture.

By placing the end of the tube beneath the surface of a 5 per cent. carbolic solution, the only air that can enter the chest is that within the tube, and this, by running carbolic water through the tube can be rendered innocuous. But the risk that this will pass up the tube is infinitesimal. Moreover, the instrument is self-acting, and if the flow of fluid has commenced, the the siphon-action—the tube being the long limb of the siphon—will ensure its continuation, unless fragments of caseous matter or floating lymph block up the canula. For the latter reason the calibre of the canula is important, and in determining it two points must be considered. In the first place, its bore must be of such size that while

it freely permits the escape of viscid fluid it will prevent the floating particles from entering it. If the bore be much greater than I recommend the lymph substance will almost inevitably enter the canula, which gradual accumulation, or the entrance of a large mass, will block. But the material cannot enter a small bore instrument, and although the lymph may float around its orifice in the pleura, a pervious channel will remain, through which the fluid steadily flows. Further, the canula should be of such strength that it will not break if a rib be struck, or if in entering or withdrawing any obstacle be met with, and if the metal of which it is constructed will bend, rather than snap, in such a case, a further element of safety will be secured. Further, the consequences of accidentally wounding adjacent organs and structures, *e.g.*, the diaphragm and liver, are likely to be much less dangerous from a small than a large-sized instrument. Again, the canula must not be less than $3\frac{1}{2}$ inches in length, and as soon as lessened resistance tells the operator that the instrument is within the chest the trocar may be withdrawn and the canula pushed "home" with safety; a hollow needle, whose extremity is within the chest, offers a sharp point which may come in contact with an expanding lung, or may, owing to a sudden movement of the patient, injure parts with which it may be in contact. A needle, not possessing the solid trocar, which, as its point must receive every violent shock, is the means of protection and source of strength to the canula, is liable to break—as I have known to occur in the hands of a competent operator. Regarding the size of the canula my experience corroborates that of Allbutt, who says that it is the large, and not the small canula that becomes blocked.*

Before I adopted the method described, I had been accustomed to use Roberts' trocar, and with very good results. It is the instrument used in tapping most of the cases related in the appendix; but the tap in it is a

*Clifford Allbutt, on Thoracentesis. Practitioner, vol. II, 1872, p. 77.

complication, and renders the instrument less easily cleaned than a simple straight trocar. It also occupies more time in use than that I describe.

DIFFICULTIES OF PARACENTESIS.

Having secured a serviceable instrument, the operation may still be frustrated or complicated by events which may occur during its performance.

These are :—

1. Non-penetration of chest, owing to striking a rib.
2. Failure to obtain fluid, although the trocar is within the Thorax.
3. Admission of air into pleura.

Or, during the flow of the fluid, incidents may occur which demand the stoppage of the proceedings.

These may be :—

Syncope.

Cough and dyspnœa.

Bleeding.

NON-PENETRATION OF CHEST. This is an occurrence which, though annoying and one to which the inexperienced operator is especially liable, can be best avoided by a recollection of the direction of the ribs. As will be learnt hereafter, I recommend the latero-dorsal aspect of the chest as that at which the operation may be best performed. In this position the ribs slope downwards from the spine towards the axilla, and in order most easily to insert the trocar, it must be impelled in a direction towards the sternum. The operator runs his finger along the interspace selected to determine its direction and obliquity after the patient's arm is lifted above his head, so as to increase the space between the ribs and remove the mass of muscles from the point of puncture, and then introduces the trocar.

It will be noted that I never make a preliminary skin puncture to facilitate the entrance of the trocar. An experience of many operations has shown me that it is not required. The Thorax is a firm structure, and does not like the abdominal wall yield to pressure, and

if a sharp instrument be employed the patient is saved the pain of two operations, viz., the lancet incision and the entrance of the trocar. Moreover, the skin, if undivided, by virtue of its elastic properties embraces the canula, and prevents the passage of air along its sides into the chest, and when the instrument is withdrawn, a mark the size of a pin point shows that the continuity of the integument has been almost restored. No after dressing of any description is needed, as must necessarily follow if a lancet incision has been made.

FAILURE TO OBTAIN FLUID. The surgeon is requested to evacuate a pleuritic effusion, which his medical colleague—the physician—confidently assures him almost fills one pleural cavity. After making all preparations, and after convincing himself by a careful and methodical examination that the chest does contain fluid, he operates; but the watched-for fluid does not flow. And this experience will occur to every performer of paracentesis thoracis. The case of Wm. Flint (case 20 in the appendix) illustrates this point. On January 28th, the chest was explored with a small exhausting syringe, when clear brown fluid was drawn from the 8th space. On January 31st, only three days later, aspiration yielded a negative result. On February 4th, four days later, the aspiration was repeated, with the result that 220 cubic centimetres of fluid were withdrawn.

The causes of the non-appearance of fluid after the trocar has been inserted may be arranged under three heads, viz:—

1. Those due to the instrument.
2. Those to the mode of operating.
3. Those to conditions within the chest or peculiar to the patient.

The instrument employed as an impediment to the flow of fluid.

The gauge of the trocar may be so narrow that the fluid cannot pass. Especially does this occur in the case of thick or viscid fluid. Or the canula may be unduly wide, so that flócculi block it. (See page 22 for further remarks on size of canula.)

If the chest be tapped with a hollow needle its orifice may become clogged with false membrane, derived during its passage into the pleura. Should this occur it will inevitably demand the withdrawal of the needle; for although, by removing the tubing, it may be cleared by the passage of a stilette, while *in situ*, there is some risk that air will then pass through it into the chest. But if a canula, filled by a well-fitting trocar, be employed, nothing can enter it until the trocar is removed, when the fluid will in all probability pass into it. And should any after-stoppage of the flow take place from a foreign body entering the canula, the running of the fluid can be quickly induced, with perfect safety, by re-introduction of the trocar.

There may be an unnoticed "kink" in the india-rubber tubing, or debris may have collected in it in quantity sufficient to block it. The former event is easily remedied, while the latter is best guarded against by testing the perviousness of the tube with a stream of water run through it before each operation. The flow of fluid can be watched, and its stoppage ascertained by the intervention of a piece of clean white glass tubing in the course of the india-rubber tubing.

Lastly, the instrument employed may not be long enough to reach the pleural cavity, owing to the density of the modified pleural membrane, the bulk of muscles or thickness of the adipose layer. Thickening of the pleura is the pathological result of continual inflammation, and is met with in every gradation between a film of flaky consistence and a massive shield as tough as leather. *Cæteris paribus*, its density and thickness are commensurate with the length of time the disease has existed. Colles* speaks of a pleural membrane of "several inches in thickness," and mentions a case where he "once operated for empyema, and had to cut cautiously through the pleura until the whole knife was in the wound."

If the subject of the operation be well nourished and of vigorous bodily development, not only may thick muscles have to be penetrated, but previous to them, a

* Colles. *Dublin Medical Press*, 1844.

considerable layer of fat. Bowditch alludes to a case "with chest parietes so thick that my usual trocar $1\frac{3}{4}$ of an inch long failed to reach the interior of the chest," in which case he says "I had simply to get a new and longer trocar, and success followed." I have already insisted that the instrument used should not be shorter than 3 inches, and about $3\frac{1}{2}$ inches long will be found most convenient. For by placing the fore finger at any distance from the point in operating it can be temporarily converted into a trocar of any length between $\frac{1}{2}$ an inch and 3 inches.

Mode of Operating as a Preventive of the flow of fluid. An essential element of success in the operation of paracentesis is what I, for want of a better term, denominate temperate boldness. The surgeon having marked out the point for his puncture, having made sure that it is far enough removed from abdominal or thoracic viscera, with one vigorous and properly-directed thrust pushes the instrument into the chest. Suddenness—not rapidity—must form a part of the operation. I have already referred to the thickened state into which the pleura degenerates, and it is in order that the trocar may pierce the altered membrane that boldness in making the puncture is called for; otherwise, instead of penetrating the membrane, especially if a blunt-pointed instrument be used, the trocar pushes it before it, and strips it from the sides of the Thorax. Thus, the cavity of the pleura remains intact; and not only may this event occur in old standing cases, but it may result where a timid hand slowly inserts a blunt-pointed instrument within a Thorax lined by a recently inflamed pleura.

Conditions within the chest, or peculiar to the patient as impediments to the flow of fluid. The causes operating under this head have been mentioned, but we may recapitulate once more. With regard to thickening of the membrane of the pleura, we may add that the trocar, although of sufficient length, may not have been pushed completely through it. I have seen this occur to a hospital physician, who, apparently unaccustomed to tap pleurisies, slowly pushed an exploring needle

between the ribs, through which, however, no fluid flowed into the syringe attached to it, until the more practical house-physician pushed it in about an inch further. Or in a very old standing case calcification of the pleura may have taken place, or the rare multiloculated form of effusion, the result of innumerable adhesions, may effectually prevent the flow of fluid. Concerning muscular development it may be again pointed out that the surgeon can regulate the position of the dorsal muscles by movements of the arm; and should such an exceptional case be met with, that, from excessive development of the muscles and fat, either the posterior interspace cannot be defined or that the operator's trocar will not reach the interior of the pleura, the spot recommended by Prof. Marshall, on the anterior aspect of the chest, may be selected with a more successful result. The axillary line—in surgical works especially—is often recommended as the most convenient point at which to tap the chest, but only a cursory examination is necessary to indicate the accumulated bulk of muscles which here protects the chest wall.

Finally, the surgeon must bear in mind that his diagnosis in a limited number of cases will be at fault, that pleuritic accumulations are sometimes simulated exactly by intra-thoracic growths, and that, therefore, no pleuritic fluid can be evacuated. But, while keeping this fact in mind, he must recollect that his puncture, properly made, does no harm in such cases; and also, that it may be possible, from a combination of some of the circumstances mentioned, to draw fluid at one point, and fail when the attempt is made at another. Dr. Goodhart mentions a case in which aspiration in the second interspace in front was the only point from which the pus of an empyema could be obtained. If, therefore, the dorsal puncture prove barren, exploration in the axillary line, or failing therein, on the anterior aspect of the chest, should not be omitted in any case where the physical signs of fluid exist. A cough or deep respiration will sometimes set up the flow of fluid after an apparently unsuccessful puncture.

The admission of air into the chest during tapping. Many discrepancies are found amongst writers concerning this detail of the operation, and until the publication of Trousseau's memoir it does not appear that the entrance of the external air during paracentesis was regarded either as an element of danger or an essential of success. Dr. Fuller* writes—"Theoretical considerations are decidedly opposed to puncturing the chest and admitting air to the inflamed pleural membrane, and practice justifies the doubt which theory suggests as to the expediency of so doing. On the one hand it is shown that the admission of air into an inflamed serous cavity is apt to be followed by suppurative inflammation even when the effused matters had previously consisted of mere lymph and serum; and that fatal consequences very commonly ensue under these circumstances." But he adds further on† "when the acute inflammatory action has subsided the admission of air is not a matter of so much importance as theoretical considerations have appeared to some persons to suggest. It does not necessarily excite suppurative inflammation of the pleura. Again, the existence of air in the pleura is not found to interfere with the re-expansion of the lung in the cases now under discussion. Its temporary admission in cases of paracentesis is of little moment. I have known all traces of pneumo-thorax disappear five days after the operation. However, every precaution should be taken against its admission." Dr. Hamilton Roe, one of the staunchest advocates of paracentesis thoracis at a time when its practice was generally condemned,‡ after citing experiments by Dr. John Davey, who injected air into the healthy pleura of several dogs "without doing any injury," a repetition of the experiments by Sir Astley Cooper, yielding a like result, says—"The cases of paracentesis thoracis which I formerly laid before the Medico-Chirurgical Society proved that air might be admitted into a pleura which

* Dr. Fuller. *Diseases of the Chest*, p. 187.

† Dr. Fuller. *Diseases of the Chest*, p. 192.

‡ Hamilton Roe. *Lancet*, vol. 2, 1851, p. 434.

had been so inflamed as to secrete serum, and even pus, without producing any serious consequences ; there is, therefore, no reason, I believe, that the mere presence of air will do harm either to a healthy or an unhealthy pleura." Trousseau's valve of gold-beaters skin or intestine was to obviate what he says is "the most serious accident, and indeed the only one to be feared in paracentesis of the chest, the persistent entrance of air into the pleural cavity, inasmuch as it may cause suppurative inflammation."*

Professor Marshall† says that "it is certainly of as great importance to avoid the entrance of air into the pleural sac in the case of sero-fibrinous as in that of purulent effusions." Gairdner.‡ "By no means participates in the notions of Dr. Hamilton Roe and others who regard the admission of air into serous sacs full of fluid effusion as a matter of indifference. There exists, indeed, a power in nature to repair this injury by the rapid absorption of the air, even while the fluid may remain for some time unabsorbed, but it by no means follows that air will always be quickly re-absorbed in such cases, and the experiments of Speiss (referred to by Dr. Roe) on the rapid removal of air from the healthy thoracic cavity prove absolutely nothing as regards the consequences of leaving it, even for a limited period in contact with fluids on which it must necessarily act in the way of chemical decomposition." And the German author, Fraentzel,§ is as emphatic as Gairdner in his recommendation to exclude air, and his opinions, though not shared by Lichtheim and Lebert, his eminent countrymen, are worthy of careful consideration. Waters||

* Trousseau. Clinical Medicine (Sydenham Society's Edition), vol. 2, p. 284.

† Marshall—Lancet, 25th Feb., 1882, p. 300.

‡ Gairdner—Clinical Medicine, p. 323.

§ Fraentzel—Ziemssen's Cyclopædia, (English Translation) Vol. 4, p. 700.

|| Waters—Diseases of the Chest, p. 211.

Allbutt* and West† likewise insist that much of the success of a series of cases will depend upon the completeness with which air is excluded from the pleura, while Anstie‡, Meigs and Pepper§, and Broadbent|| are not averse to its entrance. The series of cases recorded in the appendix does not help to elucidate this matter, nor have I the results of a number of cases where air passed into a fluid-containing pleura during paracentesis, as it has always been the care of myself and those with whom I was associated to guard against such an occurrence. In one case, that of Thomas Allen Haigh, admitted into the Huddersfield Infirmary during my house-surgeoncy, a sucking sound, when the end of the tube was incautiously raised from beneath the surface of the fluid already evacuated, announced that air had passed along its course. The case was one of "latent" effusion, and the chest, at first unilaterally dull, had been tapped twice previously. At each repetition of the operation the fluid remained serous, but after the particular paracentesis alluded to, the supervention of hectic fever prepared us for the offensive semi-purulent fluid which was next let out. Here then is a case where deterioration of fluid could be assigned to the admission of air (shall I say, germs?) within the chest. And it is upon the chest contents—the inflammatory products—that the deleterious action of the external air is exerted. Its harmlessness upon the pleural membrane, I hope hereafter to demonstrate. Now we cannot, notwithstanding the advances of "germ-theories" and antiseptic ideas, determine the degree of fermentation or putrefaction any sample of organic fluid will undergo when placed in a serous sac along with ordinary atmospheric air. It is surrounded by so many uncertain and unknown local conditions, which nothing but a post mortem examination can lay bare; it is influenced

* Allbutt—Practitioner, 1872, Vol. 2, p. 77.

† West—Diseases of Children.

‡ Anstie—Reynold's System of Medicine, Vol. 3, p. 945.

§ Meigs and Pepper—Diseases of Children, p. 240, *et seq.*

|| Broadbent—Lancet, Vol. 2, 1880, p. 941.

by the nourishment, the condition of life, and constitution of the patient, none of which elements can be reduced to a state of definite certainty; and if the fluid thrown from the pleura of a vigorous individual can remain unchanged under conditions favourable to putrefaction, viz., heat and moisture, when air is admitted, it has still to be proved that the lowly organised fluid in the cachectic subject will continue unaltered. Marshall,* affirms that the well-marked fibrino-serous liquids are the most prone to decomposition upon the admission of air; though I cannot but think with Allbutt† that it is in the case of weak subjects, in whom perhaps but little is required to weigh down the scale on wrong side of the balance, that our precautions should be most complete. Dieufaloy affirms that the tendency of an effusion to turn purulent coincides with the presence of red blood corpuscles. Usually, their number, he says, is 2,000 to a cubic millimetre of fluid, but in the highly fibrinous he has found as many as 7,000.‡ I am not aware that these conclusions of Dieufaloy have been accepted.

No author has yet ventured to suggest that the admission of ordinary atmospheric air within the chest is of benefit, the expression being that it does no harm. Now, I would remind those who write thus, that, before we can admit air into the chest during our operations, they must show that it does good; for, as long as there is any risk to our patients—and the evidence of accumulated experience proves that there is—by the admission of air, it is the bounden duty of every operator to use all the means in his power to lessen, and, if possible, obviate it. Even although, on the one hand, it cannot be absolutely shown that real danger arises, if it cannot, on the other, be conclusively demonstrated that his fears are groundless, it is still the surgeon's duty to maintain his precautions. It has

* Marshall. *Lancet*, vol. 1, 1882, p. 300.

† Clifford Allbutt on Thoracentesis. *Practitioner*, vol. 2, 1872, p. 97.

‡ *Lancet*, September 15th, 1877, p. 404.

been said that the danger of admitting air is proportionate with the quantity that penetrates to the pleura, and that if but a few bubbles gain an entrance, their action will be harmless. If the mechanical effects of the air alone be comprehended in this statement, none will dispute its accuracy; but, in an effusion prone to retrograde decomposition, a few bubbles of air are as capable of setting up putrefaction as a half-litre. And air until absorbed by the pleura acts as a mechanical hindrance to the expanding lung, while the results of cases of pyo-pneumo-thorax are more discouraging than of empyema uncomplicated by the presence of air. I have had charge also of other cases, of which unfortunately I have no records, in which air and healthy serum confined within the pleura reacted upon each other—stinking empyemata being the result. And Fuller, who took no steps to prevent air being admitted within the chest, remarks:* “Rarely does the newly secreted liquid retain a serous character even though the pleura contained simple serum before the operation was performed. The usual tendency is to the effusion of pus or sero-purulent fluid, and sometimes a few hours suffice to complete the change. Before the operation, the effused fluid is devoid of smell, provided no air has found its way into the pleura; but if air has been admitted the effused liquid is often converted into puriform matter of a low type, and emits a foetid odour.” The significance of this quotation is enhanced when it is remembered that when it was written antiseptic views and germ theories had not been broached.

By the use of the simple apparatus I have described it is not difficult to exclude air from the chest in tapping. None will pass along the sides of the canula, and none can traverse the tube as long as its end rests in the dish below the surface of the carbolic solution. And if a piece of metal be secured to the end of the tube, which

* Fuller. Diseases of the Chest, p. 197. In a more recent essay (St. George's Hospital Reports, 1870, vol. 5, p. 7.) Dr. Fuller has been at some pains to show that the admission of air into the pleura is quite harmless,

is long enough to coil in the dish, only gross carelessness or blundering clumsiness will cause it to be exposed. The quantity of carbolic solution must be measured in order that in estimating the quantity of liquid withdrawn it may be deducted. If it be desired to have a specimen of the effusion for examination, a portion may be safely collected in a conical or cylindrical glass at the commencement of the flow, if it run freely. This is the more necessary as a clear serous liquid on coming in contact with a 5 per cent. carbolised solution turns opaque and yellow, and from which the operator might assume that a serous effusion had changed to a purulent. Moreover, if a portion only of the effusion be withdrawn, the fear of a vacuum in the chest is minimised; and I have never in practice witnessed the theoretically possible passage of the carbolic solution up the tube into the vacuum in the pleura. With regard to the latter objection to tapping by means of a siphon-acting tube, I reply that as soon as it became possible for fluid to ascend the tube, the downward flow would cease from the equilibrium established between the force of its downward flow and the pressure of the atmosphere upon that in the dish. It may seem that if the end of the tube remain under the gradually increasing evacuation, air could not pass up the tube, but I prefer to previously immerse the end of the tube as described. When the operation is over, we must not forget that the trochar must be withdrawn from the chest before the end of the tubing is removed from its protective carbolic liquid.

SEQUELÆ OF PARACENTESIS.

Hæmorrhage. It is not uncommon for blood in small quantity to flow through the canula towards the end of the tapping, especially if the withdrawal of the whole effusion is attempted. The expansion of the lung ruptures adhesions, and blood flows from the vessels so torn; or the return of the displaced viscera to their normal situation, whilst the canula is still within the pleura may bring them in contact with it, and hæmorrhage occur from the slight lacerations. If either of the

above events happen the hæmorrhage *per se* will not be alarming. It is, however, desirable that it should be avoided, as pure blood added to the effusion already in the pleura, acts as a foreign body, may irritate the pleura if the whole of the effusion have been evacuated, and is prone to assume the changes of decomposition.

If the intercostal artery be wounded—an accident I mention because I find it alluded to in books—free hæmorrhage will come on; but as Trousseau observes, the accident is the result of carelessness. I have never seen the artery wounded by the passage of the trocar, and it can best be avoided by directing our puncture in accordance with the anatomical relations of the vessel. The trocar must not be introduced higher than the middle of the interspace selected, and so directed that it will pass through the parietes at one thrust.

Sanguineous effusion is diagnostic of malignant disease as the cause of effusion; and the bloody sputum after paracentesis is now seldom seen, and when met with possesses no danger. Holmes* recommends that previous to the puncture a small incision should be made as far as the upper border of the lower rib of the interspace selected, so that the finger nail may rest upon it, and serve as a guide or director to the trocar. The suggestion is feasible—but at the expense of our patient's feelings and notwithstanding its seeming advantages, I cannot but condemn it as cruel.

Wounding of neighbouring organs. The evil consequences resulting from injury to adjacent structures will be commensurate, *cæteris paribus*, with the size of the instrument, which gives rise to them. Since exploratory punctures have been adopted as a method of diagnosis, the harmlessness of entering solid organs, or even hollow viscera,—witness aspiration of the distended bladder, and tapping the tympanitic intestines—by delicate instruments, has been made manifest.

* Holmes. Surgery; its Principles and Practice. Second Edition,
p. 207.

Bowditch,* writing after an experience of 270 operations, says that he has never seen any harm done by his instrument. He punctures the chest also at a lower point than I recommend, where the trocar is in greater danger of injuring the diaphragm and abdominal organs. During the American civil war the accident occurred in a case where two small wounds were made, 2 inches outside the nipple, between the 6th and 7th ribs.† A careful physical examination will ensure that at or near the spot chosen for operation no adherent lung exists; a knowledge of anatomy, normal and pathological, should indicate the several dangers to be avoided from the contiguity or position of viscera, while a deliberate consideration of the physical state of the chest must prepare the surgeon to undertake an operation, in which prudence and common sense must play an essential part.

As soon as the trocar penetrates the pleura, its direction may be altered from the horizontal to one obliquely upwards, and when the instrument is felt to be in the pleural cavity, the trocar must be removed from the canula, which should then be pushed in cautiously, until there is no fear that it will fall out. If, in doing this, its end should press against any substance, the instrument should be slightly retracted.

Cough and Dyspnoea. It frequently happens that an otherwise satisfactory tapping has to be abruptly terminated, owing to cough or dyspnoea, or both. I have seen several pints of fluid evacuated without uneasiness or troublesome cough, but in the majority of cases one of these symptoms, and sometimes both, occurs. In the cases in the appendix it is noted in two out of 23 operations. The dyspnoea and cough are differently explained, some believing the irritation of

*Bowditch. Practitioner, vol. 1, 1873, page 194.

†“Medical and Surgical History of the War of the Rebellion,” vol. 1, p. 504. See also Watson. “Principles and Practice of Medicine,” Fifth Edition, vol. 2, p. 149.

the canula in the chest their cause, especially if it come in contact with the expanding lung, while others refer to the laceration of adhesions by the expanding lung, with the attendant influx of blood into the pulmonary vessels as their origin. Perhaps the truth is that all the circumstances mentioned are concerned in the production of the symptoms, although the greater share must be assigned to the second variety which would appear to be the primary excitant. The act of coughing then shakes the thorax, causing to and fro movements of the canula, which help to irritate the pleura and excite the cough still more. The cough does not usually come on until some of the fluid has flowed, showing that the trocar may lie in the chest unheeded, and in old-standing effusions, where expansion of the lung is hindered by thick false membranes more than in a recent case, coughing is not so frequent, although dyspnœa, due, I presume, to the vacuum left by the fluid, may be urgent. Moreover, I have occasionally felt that the canula was touching the lung, although no cough nor dyspnœa was present. Unless cough be excessive, it should not be checked, and the operation may usually be completed. Sometimes an alteration of the patient's posture will check the cough, which, being, as we believe, the result of re-expansion of the lung is a sign of favourable import within reasonable limits. It shows that the lung has not lost the power of re-expansion; while the coughing efforts forcibly tear through adhesions which would otherwise be a hindrance to the lung in regaining its normal dimensions. Rapid evacuation of fluid by a large-sized trocar is also a cause of coughing, and this supports the views I have stated concerning its origin.

If the cough become excessive or violent it is usually recommended that an opiate or subcutaneous injection of morphia should be administered to allay it. I have found that the Spt. Æth. Sulph. Co., of the British Pharmacopœia, known as Hoffman's Anodyne, answers the same purpose, and it has the additional advantage that it acts as an antagonist to the dangerous

complication of paracentesis to be next alluded to, viz:—Syncope. Its useful effects in cardiac dyspnœa are known and appreciated, but I think no one has yet pointed out its value in the treatment of similar symptoms and cough, the result of letting out fluid from the chest. In every case, an immediate refuge must not be sought in the relief afforded by drugs; as the cough, though temporarily annoying and painful, is a sign of healthy action, as well as the means of after good. And if the sudden congestion of the expanding lung be remembered, the administration of opiates, which tend to make that condition more lasting, is contra-indicated. However, in a severe case five minims of the *Tinctura Opii* may be advantageously combined with half a fluid drachm of Spt. Æth. Sulph. Co. diluted with half-an-ounce of water. Bowditch* observes, when writing of the features of 270 cases, “I have not been obliged to use opiates *except once or twice* to check extravagant cough; I should never check a mild one as it is usually the healthful sign of expansion of the lung.” An elastic bandage applied firmly round the lower part of the chest is a safe and often effectual means of checking the cough. Dyspnœa is one of the indications that the quantity of fluid withdrawn must not be increased, and is a sign of more import and demands more attention than the cough. Its value as such will be reserved for discussion at a later stage.

Surgical Emphysema after Paracentesis. Unless the pleura contain air, it is difficult to conceive that extravasation of air into the cellular tissue should occur, except an imperfect physical examination allow puncture of an adherent lung, or a rash operator wound a compressed lung by incautious manipulations. I have never met with the accident. It is more apt to follow incision than paracentesis of the chest, and modern improvements adopted in the instruments used

* Bowditch. Practitioner, vol. 1, 1873, p. 194.

in the latter operation appear to have stamped it out. Trousseau makes no mention of it, nor does Bowditch give any intimation of his familiarity with it. It is a complication always to be avoided, and the knowledge that it may occur should urge the surgeon to relax none of his efforts to prevent air from entering the chest during his operations.

Syncope and allied complications. It would be a cause of satisfaction if the frequency of syncope and other complications, or immediate sequelæ of paracentesis could be ascertained. At the present day this would be impossible, as the operation is now performed by all classes of practitioners, from the pure surgeon to the obscure general practitioner. And if the risks of the operation included under this head are as numerous as some of its opponents assert, it is strange that we do not hear more of them. Bowditch and Trousseau, to the results of whose practice I so frequently refer, have not lost a patient from the operation of these causes, while Ewald, in an *resumé* of 250 cases, makes no mention of the complication.*

That syncope may occur after the operation none will doubt, and as a prophylactic I insist upon the recumbent position, before, during and after the operation. Bowditch† says, "after the operation I advise entire rest for 24 hours at least," though with what intention is not stated. Fraentzel‡ also advises the semi-recumbent position for the operation. One of the lessons early inculcated by a respected and eminent teacher was, never to perform the smallest or most trivial operation without previous preparation of the patient, and examination of his state of health; and if this rule were applied to the operation we are considering whenever possible, perhaps the occurrence of syncope and other complications would be less frequent.

* Ewald. London Medical Record. July, 1882, p. 285.

† Bowditch. Practitioner, vol. I., 1873, p. 194.

‡ Fraentzel. Ziemssen's Cyclopædia, vol. IV., p. 706.

In any case brandy should be at hand ; and although I have never used the drug, nitrite of amyl, as employed in chloroform syncope suggests itself. A feeling of faintness, the supervention of pallor of the face, failure of the pulse, and breathlessness should be regarded as demanding the peremptory stoppage of the operation, and withdrawal of the trocar ; for, there are reasons for assuming that these symptoms have been produced by reflex irritation of the pleural and pulmonary nerves. And if a foul smell or a ghastly sight, can in strong men induce syncope, the capability of an operation upon sensitive organs to produce the like result is, after all, not to be wondered at. Bearing in mind the effect of impressions upon a patient, who if nervous, will be in a suspended state of dread, it will be the surgeon's aim to make his preparations for the operation out of sight of the patient ; indeed, by standing behind the patient it is possible to make the puncture without permitting the patient to see any of the instruments beforehand. In very sensitive patients the pain of the puncture may be prevented by local anæsthetic means, as introduced by Dr. Richardson.

Sudden death has occurred during or shortly after paracentesis, and cerebral embolism, pulmonary thrombosis and reflex irritation of the nerves of the lung, especially the vagus* have been stated as its cause in different cases, in addition to that already mentioned. Its occurrence excited almost simultaneously the attention of French and English physicians in the years 1875-6. M. Legroux† reported the case of a man of prior good health who presented an immense effusion from pleurisy of a month's duration. About $2\frac{1}{4}$ litres had been discharged, greatly to the patient's relief, when he suddenly fell faint and died. The autopsy

* See cases by Dr. Habershon, on cold shock in its action on the pneumo-gastric nerves. *Lancet*, vol. 2, 1881, p. 1124.

† Legroux. *Gazette Hebdomad*, Sept. 3, 1875, quoted in *Medical Times and Gazette*, Oct. 2, 1875, p. 558.

furnished no explanation of the fatal occurrence. M. Legroux recommends that the fluid should not be all withdrawn at one operation. The cause of death in this case would appear to have been syncope, and also in the following reported by Dr. Broadbent, to the Clinical Society.* The patient was a shoemaker, aged 62. Aspiration was practised for an effusion into the left side; no powerful suction was employed, and it was not considered prudent to empty the chest completely. The heart returned nearly to its former position. The patient was in excellent spirits up till 5 p.m., when he had tea; half-an-hour later he was found in bed dead. At the same meeting of the Clinical Society, Dr. Cayley† read notes of a case, of which the following is a *resumé*:—Patient was a man, aged 36, admitted into Middlesex Hospital five weeks after being attacked by pleurisy. The case was found to be one of multilocular empyema, and the cavity was washed out, after incision of the chest, with a weak solution of Iodine. The injection had been repeated ten times, and during the employment of a rather larger quantity than usual the patient became deadly pale, his pulse slow, breathing gasping and pupils dilated, which symptoms were immediately succeeded by rigidity and general convulsions. The temperature rose to 107° Fahr., the man remained comatose, and died in 16 hours. No thrombosis or embolism, nor any other condition was found accounting for the onset of the symptoms. It is evident that the case related by Dr. Cayley presents features differing materially from the phenomena noticed in those of Drs. Legroux and Broadbent, and its untoward termination must be referred to some other cause than syncope. M.

* Broadbent. *Medical Times and Gazette*, 1876, p. 558. In the discussion at the same meeting, Dr. Goodhart related the occurrence of epileptic convulsions after an incised empyema had healed. On post mortem examination abscesses were found in the brain.

† Cayley. *Medical Times and Gazette*, Nov. 1876, p.p. 557-8.

Maurice Raynaud* brought forward the history of three deaths resulting from paracentesis at the Société Médicale des Hopitaux; and a discussion, interesting from the views put forward to elucidate the obscurity of such cases took place at another French Medical Society some time afterwards.† M. Leven gave details of a sudden death after paracentesis, and concluded from the symptoms, and the result of the *post-mortem* examination, as well as by a process of elimination, that bulbar irritation of the nerves of the lung, especially the vagus, was the excitant. Charcot, partially accepting Leven's views, referred to a patient the subject of gout, and who often when seized with cough, fell down as though struck by lightning. Another patient, who was also troubled with cough which had no special character, suddenly fell down when it came on. In neither case was there any sign of syncope or epilepsy. Charcot was inclined to regard such cases as a kind of "laryngeal vertigo," analagous to Menière's disease. These speculations are worthy of note, and let us hope that it may not be our lot to confirm or overthrow them by witnessing an example of this accident, and as we are forewarned let us be amply fore-armed. In all recorded cases of the class related by Dr. Cayley, the onset of the symptoms has been sudden and unexpected. Therefore, we must operate as though the symptoms were about to set in, and by dexterity, prudence and gentleness, by the avoidance of unnecessary injection of fluid into the pleura, and by the withdrawal of a portion of the effusion, not induce dangerous symptoms in a patient, who for all we know, may be predisposed to them.‡

*Raynaud. Quoted in Medical Times and Gazette, vol. II., 1875, p. 664.

† Gazette des Hopitaux, Nov. 21st, 1876.

‡For other cases see Watson. "Principles and Practice of Physic, 5th Edition, vol. 2, p. 146, 2 cases. *Lancet*, May 8, 1875, p. 657, case recorded by Dr. Earnest Legendre; August 7, 1875, p. 216, case recorded by M. Ernest Besnier.

There is one point, however, which should be remembered, that a full pleura is as fruitful a cause of sudden death as operative interference. Lastly, I consider it my duty to hold out a still encouraging hand to him who skilfully performs appropriate paracentesis. In an experience of about 70 operations, I have never seen one of these untoward misfortunes. I have alluded already to the unblemished experience of Trousseau, Bowditch, and Ewald, and I have a firm conviction that, when done with care, the operation is practically free from these disadvantages.* Faintness, never amounting to syncope, but once or twice evidenced by pallor of the face, I have witnessed in a limited number of cases. It has never been alarming, and with judicious after-care has permanently disappeared. With the result of Dr. Broadbent's case to guide us, complete repose, as well as the avoidance of a full meal soon after the operation, should be insisted on.

The exact pathology of death during, or soon after, tapping the chest has not been determined, and although embolism is requisitioned as an explanation, I can only find reference to one case in which its occurrence was actually determined. Full details of the case are given by Dr. Balthazar Foster.† Death occurred 13 days after paracentesis had been performed, and on post mortem examination, the iliac and renal arteries were occluded by coagulum. The left ventricle contained three branched clots, and on opening the left auricle a similar branched pale coloured clot was seen protruding from one of the pulmonary veins on the right side. Dr. Foster believed that the embolus had originated in, and

* Dr. Evans, in an elaborate article in vol. 2 of "St. Thomas' Hospital Reports," asserts that out of 820 cases he had collected, in two only did death follow the operation.

† Clinical Medicine. Dr. Hermann Weber mentioned at the Clinical Society four cases of death without operation, two in adults and two in children. In two there was embolism of the pulmonary artery, in one of the cerebral arteries. *Lancet*, Nov. 4, 1876, p. 642.

been detached from one of the pulmonary veins of the right side. I must refer the interested reader to Dr. Foster's work, as the account of the case from the well-known accuracy and acumen of the observer will well repay perusal.

Albuminous expectoration and Œdema of Lungs. These events seem to be the bugbears of French writers.* In only one of my cases have I noticed any approach to the marvellous quantities of fluid expectorated which some French operators record, and this case is related in the appendix herewith (Tom Wray, case 19) The fluid was distinctly albuminous. M. Revillont has met with albuminous expectoration in patients who have not had pleurisy. Should dyspnœa come on after the operation and threaten to become dangerous, stimulants, the sitting position and possibly bleeding would prove of most service.

Hæmaturia. I have observed this symptom on one occasion, and believe it to be a sign of the worst import. (See case 38 in Appendix).

Pyrexia. It was Trousseau's boast, and one of the arguments of his enthusiastic advocacy of the operation, that it reduces temperature, and I have been somewhat surprised to read that "after puncturing, patients without fever become feverish for a day or two, and in feverish cases a moderate rise of temperature takes place."† In eleven of the operations recorded in the appendix where the thermometric observations have been preserved in one only is any rise of temperature noted after the tapping. The results are as follows:—

No of case in appendix.

17. Gradual rise commencing three days after tapping.
18. Fall from 102° to 99° in two days.

* See Medical Press and Circular, June 29th, 1881, p. 552.
See especially British Med. Journal, Oct. 4th and 11th, 1873.
Duffin. British Med. Journal, March 21st, 1874, p. 372.
Johnson. Ibid, Oct. 25th, 1873, p. 479.

† Fraentzel. Ziemssen's Cyclopædia, vol. IV., p. 712.

24. Case of tubercular pleurisy, tapped three times.
 After first operation. No rise.
 After second do. In four days slight rise
 After third do. Fall, and then considerable rise for four days and then fall.
27. Immediate gradual fall.
28. do.
31. No alteration for a week, then rise of one degree followed by gradual fall.
32. Immediate gradual fall.
35. do.
36. Immediate fall, and rise in five days to former standard. Fatal case.

I am unable to confirm Fraentzel's statement on this point, for my experience has been that paracentesis relieves fever, and the symptoms denominated febrile, and does not induce it in cases where it is absent. I have never applied ice to the chest wall, with the object of arresting it, and although it may do good by contracting the walls of vessels distended by inflammation, and notwithstanding that it has the recommendation of Traube, I have never seen occasion to employ it even for the last-named purpose. However, I leave the matter *sub judicé* that the reader may use his own judgment when dealing with cases.

CHAPTER III.

PARACENTESIS THORACIS.—WHERE TO PUNCTURE

The sixth interspace in the axillary line is the orthodox position for puncturing the chest, but on account of the thickness of the muscles in the axilla, the region anterior or posterior is more convenient, for, the width of the interspaces is less in the axillary line than in front or behind it, and offers more obstacle to the insertion of the trocar. Coming from the spine the ribs gradually diverge from each other, but approximate slightly in the axilla, diverging again as they pass forwards to the sternum. I advise that the "point of election" be the 7th or 8th interspace, about the junction of the anterior two thirds, with the posterior third of the chest wall, a point which may be advantageously indicated by the landmark I have discovered and introduced (*see p. 13*). The surgeon can conduct all his manipulations behind and out of sight of the patient, the trocar is introduced between the ribs at this spot without difficulty, and with more ease than if the axillary line be chosen, and the patient after the insertion of the trocar lies comfortably in bed, protected from shock and cold by his usual covering of bed clothes. The danger to the lung is also reduced to a minimum, for if a trocar be introduced from the front it passes almost in a line towards the lung driven by the fluid to the back part of the chest cavity; whereas, when entered, external to the compressed viscus, it is only in those exceptional instances where the lung reaches the anterior chest wall, there is fear that the trocar may injure it. Should, moreover, expansion of the lung set in before the canula is removed, there is more risk of its receiving damage from meeting the end of the canula, against which it will

press, than by weighing down upon the whole length of the instrument. The diaphragm rises in the chest nearer to its anterior than its posterior wall, and hence, the possibility of injuring it is less when the posterior point is chosen. In the case of a left sided effusion, a trocar which pierces from the front is in danger of wounding the pericardium and heart. Indeed, I have heard of an empyema which was aspirated in the fifth space anteriorly; and, although pus had been previously withdrawn from the child's chest by the exploring syringe, serous fluid flowed into the aspirating bottle, until the needle was pushed in more deeply. It was supposed that the pericardium, which contained serum, was first entered, and that on transfixing the posterior pericardial lining, the pleural cavity was reached, and the empyema evacuated. I cannot refrain from mentioning that the cellular elements of a purulent fluid may sink, and leave a comparatively clear superstratum, as may possibly have occurred in the case just related, although, as I did not see it, I feel compelled to accept the evidence and conclusion of him who did.

I would not puncture lower than the 8th interspace, in the first place that I might not wound the diaphragm, and in the second, because collecting lymph and thick false membrane are, from the action of gravity, most abundant in the lower part of the chest; and thirdly, because the pleura most readily strips from the chest wall, and is most readily pushed before the trocar at the lower depth of the cavity. The relations of the diaphragm to the 8th space have been mentioned, (*see p. 13*). The deposit of lymph material is not usually an obstacle to tapping, at or above the 8th space posteriorly, but should it prove so, that point of the 5th or 6th interspace, in front of the axilla, where the serratus magnus and obliquus externus interdigitate may be selected.

Among authors unanimity in the choice of the site of puncture does not obtain. But, except as far as the details relative to the operation itself are concerned, and as long as fluid can be safely withdrawn, the "point

of election " is not of so great importance as is the best place for the operation for purulent accumulations where good after drainage is imperative. There is left, therefore, some freedom of choice, but the wise operator will accustom himself to one particular spot, at which practice will confer upon him that self-reliance and knowledge of detail so essential in all surgical undertakings. Some recommend that the chest should be punctured, where fluctuation is most easily felt, or where bulging is most apparent: the former is a sign more often absent than present and of little value as a guide; whilst the latter indication is of no import, being the physical result of pressure upon the weakest part of the chest wall, and will disappear if tension be relieved, at whatever point that relief is afforded. Under no circumstances can it be construed into an "effort of nature."

The following list gives the point at which many of the leaders of the profession practice paracentesis:—

TABULAR VIEW OF SPOT RECOMMENDED FOR PARACENTESIS.

REGION OF CHEST.	AUTHORITY.	DETAILS.	REFERENCE.
Near the Sternum..	David ..	.. ..	Memoir pour le prix de l'Académie
Wherever pain or fluctuation may direct .. }	Bell ..	.. ..	Surgery, vol 2, p. 390
Any point desirable	Cruvelhier ..	.. ..	South's Chelius, 6th Edition, vol. 2, p. 474
4th Interspace ..	Paré ..	.. ..	Rust. Theoretisch Praktisches Handbuch der Chirurgie, Berlin, 1834, p. 57
from above.	Severin ..	.. ..
	Camper ..	.. ..
	V. Ammon ..	.. ..
5th Interspace ..	Fabricius ..	.. ..
from above.	Paulus Ægineta ..	.. ..
	Aquapendente ..	.. ..
	Dionis ..	.. ..
	Barbette ..	.. ..
	Lænnec ..	.. ..
	Chelius and South ..	Between Mammary and axillary lines, near former	Diseases of the chest
		In axillary line on left side ..	System of Surgery, by South, vol. 2, p. 474, 6th Edition
	Sharp ..	.. ..	Critical Enquiry, &c., chapter 6
	Heers ..	.. ..	Observ. Medicæ. Leodii, 1622
	Druitt ..	A little behind middle of ribs ..	Surgeon's Vade Mecum, 9th Edition, p. 528

REGION OF CHEST.	AUTHORITY.	DETAILS.	REFERENCE.
5th Interspace	Tanner ..	Somewhat anterior to digitations of serratus magnus ..	Practice of Medicine, 6th Ed., vol. 1, p. 589
	Erichsen ..	Lines of insertion of serratus magnus ..	Science and Art of Surgery, 6th Edition, vol. 2, p. 471
	Guthrie ..	One-third distance from vertebræ and two-thirds from sternum. If spaces protrude, a rib or two lower ..	Commentaries, p. 425 <i>Lancet</i> , July 30, 1881, p. 175
	Southey .. Wood (King's College) ..	In axillary line ..	<i>Lancet</i> , May 9, 1874, p. 645
	Fraentzel ..	Where there is bulging, or 5th and 6th interspace ..	Ziemssen, vol. 4, p. 706
6th Interspace from above.	Morgan (Manchester) ..	At point chosen by Laennec. 4th space on right side ..	<i>Lancet</i> , Feb. 26, 1880, p. 326
	Bryant ..	In axillary line ..	Practice of Surgery, 2nd Edition, vol. 2, p. 42
	Marshall ..	Midway between sternum and spine, or 7th if desirable ..	<i>Lancet</i> , March 4, 1882, p. 347 <i>Lancet</i> , 1862, vol. 1, p. 572
	Hillman .. Barlow, G. Hilaro	In axillary line or at 7th space or wherever exploration has proved existence of fluid ..	Manual of Medicine, 2nd Edition, p. 273
	Berkeley Hill ..	Between angles of ribs ..	<i>Lancet</i> , July 17, 1875
		In infra axillary region ..	

REGION OF CHEST.	AUTHORITY.	DETAILS.	REFERENCE.
5th Interspace from above.	Trousseau..	Four or five centimetres external to outer border of pectoralis major, or in 7th space ..	Clinical Medicine. Sydenham Society's Ed., vol. 3, p. 271
	Cheadle ..	In axillary line, or 7th space ..	<i>Lancet</i> , Nov. 12, 1881, p. 822
	Scultetus ..	.. .. ..	Rust. Opus cit.
	Sharp ..	.. .. ..	.. .. ..
	Bromfield ..	.. .. ..	.. .. ..
7th Interspace from above.	Gooch ..	At digitation of serratus magnus	Cooper's Surgical Dictionary, 1872, vol. 2, p. 439
	B. Bell ..	Just in front of angle of rib, or in 8th space	Practical Surgery, p. 715, 3rd Edition
	Cooper ..	Below angle of scapula, or 8th space, but when choice exists choose the higher space ..	Guy's Hospital Reports, Series 2, vol. 2, p. 366
	Fergusson..	.. .. ..	.. .. ..
	Cock ..	.. .. ..	.. .. ..
8th Interspace from above.	Bowditch ..	In a line with angle of scapula; at least 1½ inches above a horizontal line drawn through lowest point at which respira- tory murmur is heard on opposite side	Practitioner, vol. 1, 1874, p. 194
	Anstie ..	Ibid..	Reynolds' System of Medicine, 1871, vol. 3, p. 945
	Bristowe ..	Ibid..	Theory and Practice of Medicine, 1st Edition, p. 425
	Broadbent	Below angle of scapula ..	<i>Lancet</i> , December 11, 1880, p. 940

REGION OF CHEST.	AUTHORITY.	DETAILS.	REFERENCE.
8th intercostal space from above.	Garencut ..	Four finger's width below scapula	Rust. Op. Cit.
	Le Dran ..		
9th intercostal space from above.	Nuck ..	Five or six inches from spine Close to union of anterior $\frac{2}{3}$ with posterior $\frac{1}{3}$ of chest wall, or 10th space	Text book of Operative Surgery, translated by Norton, p. 244
	V. Walther Bernard & Huet		
10th intercostal space	Hippocrates	9th on left side	Rust. Op. Cit.
	Vesalius ..		
	Tulpius ..	8th on right side	Rust. Op. Cit.
	Plattner ..		
	Ollenroth ..	.. ..	Rust. Op. Cit.
	Le Blanc ..		
	Pelletan ..	.. ..	Rust. Op. Cit.
	Sabatier ..		
	Richeraud..	.. ..	Rust. Op. Cit.
	Larrey ..		
No interspace mentioned	Lusitanus ..	Four finger's breadth from spinous processes of vertebrae and same distance below the scapula	Rust. Op. Cit.
	Heister ..		
	Desault ..	Four inches from spine and four inches below angle of scapula Two inches above inferior limit of sound lung in a line with angle of scapula	Lectures on Theory and Practice of Surgery, vol. 1, p. 223
	Chopart ..		
	Langenbeck	.. ..	Lancet, Feb. 5, 1876, p. 200
	Colles ..		
	Wake ..	.. ..

During the war of the Rebellion, in America, in 19 cases where point of puncture is mentioned, the following were the positions selected by the various military surgeons.*

5th interspace...	In axilla	...	...	...Twice
6th	„	...Anteriorly...	...	...Once
6th	„	...Posteriorly	...	...Once
6th	„	...In axillary line	...	...Five times
6th	„	...Five inches from sternum	Once	
8th	„	...Posteriorly	...	...Six times
10th	„	...Latero. posterior aspect...	Once	
11th	„	...Latero. posterior aspect...	Once	
Just below the shoulder blade		...	...	...Once

It is probable that in the tabular survey of the favourite position of each operator, I may have misconstrued his meaning of the word paracentesis, and thereby included the point at which he would incise the chest, instead of perform the simple operation. Wherever I have done so I offer my apology, and beg that the meaning of paracentesis may be made more fixed and determinate.

Among modern operators, the list teaches that three divisions may be made, viz., those who follow Laennec, and operate at the 5th space antero. laterally, and who include Chelius, South, Tanner, Erichsen, Fraentzel, Cooper, and Wood; those who select the axilla, following Trousseau's example, as Southey, Marshall, Bryant, Berkeley Hill, Cheadle and Morgan; and lastly, the imitators of Bowditch, namely Cock, Anstie, Bristowe, Broadbent, Colles, Waters, Guthrie, Fergusson, Bernard, Huette, and Druitt, who prefer the postero-lateral region, which for reasons already mentioned is that selected by the writer. It should be noted that the 8th interspace is at this spot, on a level with that part of the 5th interspace recommended by Laennec.

* Medical and Surgical History of the War of the Rebellion, vol. 1, pp. 449, 493, 504, 513, 573, 579, 583.

QUANTITY OF FLUID TO BE REMOVED.

If during the flow of the effusion through the canula, no symptoms demanding its stoppage occur, should all the fluid or a portion only be withdrawn? Modern authorities recommend that it is not desirable to completely empty the pleural cavity, and the success which attends their practice is the best proof of its wisdom. If the whole effusion be drawn off, more will be formed, especially in cases of some duration, as it will be impossible for the lung to at once fill the space then left. The return of the lung to the expanded state is a process, deliberate and slow, and "sometimes, and particularly in cæthectic subjects, it is weeks and even months after the re-appearance of the respiratory sound near the clavicle, before it is perceptible in the inferior parts of the chest, and often for months after the convalescence of the patient it is only one half so distinct in the affected side as in the sound one. This is owing, I conceive, partly to the very slow process by which the false membranes are converted into cellular substance, and partly to the diminution of the inherent action of the lung, on account of the long compression which it had undergone."*

The lung, incapable of expanding to fill the vacuum produced by the tapping, the chest wall is forced inwards by external pressure; the production of emphysema upon the pulmonary surface, with escape of air into the pleura is favoured, whilst the pressure upon the vessels ramifying upon the walls of the chest is suddenly changed from an external to an internal one, promoting their distension, congesting the pleura, and favouring the renewed production of the effusion.

It may be alleged that some of these statements are hypothetical, and have not yet been proved to be absolute facts, but it must be noted that they sufficiently answer two of the orthodox objections to paracentesis, viz: the production of emphysema of the lung, and the

* Laennec. Diseases of the Chest, translated by Forbes, p. 446.

certainly of a renewal of the effusion. But the distortion of the chest wall after tapping is an acknowledged truth, and would not occur if the lung were able to fill the residual space left in the pleura; and if the magnitude of the power within the pleura is such that bony structures can be bent, that the curve of the spine can be altered, is it not also capable of inducing dilatation of the pleural capillaries and rupture of pulmonary air vesicles? When syncope occurs after a rapidly performed paracentesis abdominis, none dispute that the removal of pressure from the abdominal blood vessels has allowed their distension, so that the cerebral functions are in abeyance owing to the loss. And the result of prolonged and extreme pressure upon the pleural vessels will tend to paralyse their coats so that they are unable to prevent the influx of blood when the pressure is removed. Thus the conversion of a serofibrinous into a seropurulent or purulent liquid is favoured. It can still, however, be urged that the more complete the vacuum, the more powerful will be the tractive force upon the lung.

But whatever be the strength of the suction power dragging the lung, it cannot act upon its whole thickness, but chiefly upon the surface exposed to the pleural vacuum.

The expansion of the lung is normally a slow process, and can be as efficiently secured, by removing small portions of an effusion as by endeavouring to evacuate the whole quantity. The traction upon the lung is then more gentle, and not so likely to lead to the dislodgment of thrombi from the pulmonary or other vessels, and the vessels of the pleural lining, relieved of tension, distend. Their distension is prevented from becoming extreme by the pressure of the fluid left behind, and the pressure being now greater in the pleura than in the vessels, endosmosis towards them from the pleura is promoted, and the absorption of the fluid by the vessels begins. We may presume that when—the level of the fluid being lowered by a partial evacuation—the uncovered vessels distend, there will be a tendency for the liquid contained in the vessels

still immersed by the effusion to pass upwards. If this view of a possible method of absorption be adopted, the beneficial consequences of the removal of a small portion only of a pleuritic accumulation will be perceived. The removal of a limited quantity of the liquid is the best safeguard against the accidents of paracentesis, especially albuminous expectoration and dyspnœa.

Authorities on the matter—though perhaps somewhat divided in their opinion—generally recognize œdema of the lung as the main factor in the production of albuminous expectoration. A more able and competent writer* than myself observes—"It seems to me that we have in a limb compressed by Esmarch's bandage and rope, a condition closely analagous to that of a lung compressed by an extensive pleurisy. When the apparatus is removed, it is often observed that a blush of redness diffuses over the part. Sometimes, but by no means invariably, a troublesome hæmorrhage will then ensue from the cut surfaces. The reason of these I take to be, that the pressure has not only emptied the vessels, but has also compressed the nerves of the limb, and among others the vaso-motor nerves. When the blood returns to the extremity, it finds the small vessels not only empty, but lax, owing to vaso-motor paralysis. A similar condition exists in a lung which has just been relieved from the pressure of a considerable effusion. Its vaso-motor nerves, I take it, are also compressed. As the lung again expands, the tension thrown upon its small vessels is not only sudden, but very great. When the nerves have had a few hours to recover, and blood to revive upon, their controlling action again asserts its influence, and the arterial tension is again brought up to the normal. We can thus account for the rapid and violent onset, as well as for the very short duration of this albuminous expectoration." As a supplement to this quotation, I may mention that at the hospital to which

* Duffin. *British Medical Journal*, Mar. 21st, 1874, p. 372.

I belong, in cases of excision of the knee, Esmarch's bandage has been discarded, owing to the after-oozing which occurs.

Respecting the actual quantity to be removed, I would limit it to two pints, and to a less quantity than this should troublesome symptoms already discussed come on. In cases where displacement of organs is marked, we may venture to exceed the two pints, for the structures will partially return to their normal situations during the operation, thus keeping up the pressure within the pleura; and one of the most instructive and beautiful phenomena of the operation consists in the gradual swinging round of the heart's apex towards its usual site.

In every case the position of the displaced organs should be accurately noted, after, as well as before the operation, as during the progress of the case, while apparently the quantity of pleural fluid remains unchanged, the fact of their further recession proves that absorption is going on. In no case, however, should I remove more than three pints, and when the pleura is not full one pint will suffice to relieve dangerous symptoms.

The fluid must not be drawn too rapidly, but in a steady, gentle, continuous stream. By rapid evacuation syncope is favoured, although I am unable to see the necessity for the plan of Dr. Southey, who leaves his trocar in the chest for a long period (in case recorded for 28 hours, and patient fainted during the operation)* Œdema of the lung, entrance of air within the pleura and rupture of the pulmonary vesicles are also more likely to take place by a rapid evacuation. The method of tapping I adopt fulfils the requirements of gentle speed with efficient removal of fluid, and if the fluid run through the tube too rapidly, compression of the tube will regulate the flow. The displacement of clots when a displaced heart recovers its position is less likely than when the flow of fluid is rapid.

* Southey. *Lancet*, 1878.

The admission of air into the pleura, an event to be scrupulously avoided during the operation, is much more likely to occur when by full evacuation of the fluid a vacuum is left in the chest. I admit that the danger exists if only a modicum of liquid be taken away, but it is then much less formidable.

Having evacuated the requisite quantity of fluid, the case must be watched, and if increase of effusion show that absorption is not going on the operation may be repeated as often as necessary. When complete, removal of the fluid has been attempted, recurrence of the fluid, though not to the same extent as before the operation, is the rule. If, therefore, in a case of partial evacuation, a slight increase should occur, we should not too hastily conclude that absorption will not set in, medical and local treatment to be afterwards pointed out, being meanwhile adopted.

I am prepared to admit that in many cases, perhaps in a majority of a large series, complete evacuation will be a successful operation, but, the greater safety of withdrawal of only a portion (repeating the operation when necessary) and in my hands the better results I have had since practising it, have induced me to discontinue the former practice. Unfortunately, I have no statistical tables of my own to offer, as nothing has been heretofore further from my intention than the compilation of an essay upon pleurisy.

OTHER MODES OF OPERATING.

Inventive genius and skilled workmanship have produced instruments which have banished such agents as caustics, red hot irons, issues, tents, and cupping glasses, as means for tapping the chest; and of modern inventions none reflects more credit upon the surgical instrument maker than the aspirator. Drs. Protheroe, Smith and Dieufaloy claim the honour of its invention. It is extensively used in removing fluid from the chest, for which purpose the results recorded by Bowditch have secured it a place in professional estimation.

The chief advantage claimed for it is that by its use, air can be most effectually prevented from entering the

chest. But there have been improvements in the method of tapping, as well as in the development of aspiration, and it is somewhat startling to learn from a recent and eminent writer that "if a trocar and canula be used, however fine or specially constructed, air will often pass in along or by the side of them into the pleura, and almost certainly so in the repeated use of these instruments."*

If my precautions be fulfilled no air can pass through the canula during tapping, and as regards the danger of air passing alongside of the canula, the advantage I assert is not on the side of the aspirator; for by aspiration the fluid is forcibly drawn from the chest, and if the expansion of the lung does not keep pace with the removal a vacuum is left, which the external air will tend to fill.

My practice, even after repeated tapplings, has not confirmed Mr. Marshall's experience, which I can only explain by supposing that it refers to cases of complete emptying of the pleural cavity. And the danger of admitting air within the pleura is not—from the construction of the instrument—to be disregarded during aspiration. When quite new the apparatus is air-tight, but after a short service in use, the coincident entrance of air into the barrel is shown by the bubbles which well up in the fluid as it is sucked from the pleura. If air enters the apparatus at the same time as the fluid, it will also be drawn into the vacuum before the tap which admits the fluid is open; and, should the previous vacuum be induced some time before operating, there is a risk that air will pass into the pleura. A turn of the wrong tap, an incautious working of the piston, the fall of the tube connecting the interior of the apparatus with the pleura from either the needle or the barrel of the machine—as I have known to occur, from a sudden movement of the patient, or from no readily explainable cause—may at any time let air into the pleura. The hollow needles

* Marshall. *Lancet*, March 4, 1882, p. 337.

usually supplied with the instrument in England are objectionable for our purpose, as they may become blocked, and there is no means of clearing them save by withdrawal, or forcing a passage with some liquid, which—going into the pleura—is to be deprecated.

The aspirator undoubtedly gives more control to the operator over fluid in the chest, and on this account is of much use in limited, sacculated, multilocular and viscid effusions which require evacuation. Likewise, also in the case of young children—though the major operation of incision is that more frequently required in their cases—it has advantages over the siphon tube. But in cases of abundant effusion—occurring in elder children and those too old to come within that category—the siphon tube will be found to fulfil all necessary purposes. Writers are apt to overlook the siphon action and its power, and when we remember the facility with which a cistern of water or bottle of syrup, supporting the ordinary atmospheric pressure, is emptied, we can appreciate the readiness with which a liquid sustaining the atmospheric pressure, *plus* that which the physical conditions of the chest impress upon it, can be drawn down that limb of the siphon whose length is so disproportionate to that within the pleural cavity.* It has also been claimed that the aspirator, by reversal of its action, is of much use in washing out the pleural cavity ; but in those exceptional cases requiring it, this procedure can be more safely carried out by the siphon tube, alternately altering the position of the long limb, as in the operations of washing out the stomach and bladder. No man would wash out a stomach with the stomach pump if the more safe siphon tube was at hand, and when we see the grumous, thick, lumpy material which can be drawn up from the stomach, we can comprehend the feasibility of a like procedure when the pleura is

* I have found that simple syrup of the B.P. strength can be easily siphoned from one vessel to another, though the long limb of the siphon be only four inches below the level of the short one.

affected. And, moreover, the process by this method is automatic and more gentle than the forcible pressure put upon the fluid by the aspirator.

I have given the aspirator a fair and impartial trial, and I have noticed that besides being complicated and liable to get out of order, its use is more fatiguing to the patient, so that I now limit its use to the cases indicated, and I find that Broadbent* and Allbutt† have returned to the use of the siphon tube, which has also been the case at the hospital from which the first 35 cases in the appendix are taken.

Fraentzel, Bowditch, and Anstie employ the aspirator, and Wardell‡—whose thoughtful article well deserves perusal—uses a flattened trocar, to the free end of which is attached a piece of tubing carried under water. The best form of aspirator to employ is one the piston of which is worked by a rack and pinion, and if possible Fraentzel's needle with trocar should be used. Rasmussen, of Copenhagen, has devised an excellent aspirator.§ The instrument should be tested before using to ensure that it is in working order. Potain's bottle aspirator, of which a very cheap and serviceable modification is made by Arnold, is also a useful apparatus.

Potain's Modified Paracentesis.—

The introduction of Potain's name reminds me that he is the originator of a method which has some advocates in England, viz., Drs. Hensley and Gilbert Smith.|| Two trocars are introduced through an intercostal space, one being in connection with an antiseptic solution—iodised or carbolised water—and through the other the liquid is evacuated. By an ingenious arrangement of stopcocks, the effusion can

* Broadbent. *Lancet*, Dec. 11, 1880, p. 941.

† Allbutt. *Medical Times and Gazette*, May 16, 1874, p. 527.

‡ Wardell. *British Medical Journal*, Dec. 12, 1874, p. 737.

§ *Dublin Journal of Medical Science*, vol. 52, Aug., 1871, p. 60.

|| Gilbert Smith. *Lancet*, November 6, 1880, p. 735.

be withdrawn through the one simultaneously with the introduction of the medicated solution through the other; and if blocking of the tubes occur during the operation, it may be remedied by reversing the current. I shall allude elsewhere to the dangers of washing out the pleural cavity, and cannot, therefore, recommend it, and by the close operation, it is impossible to clear the pleural cavity of clots or lymph, one piece of which left behind is as capable of producing irritation as a hundred. The medicated fluids irritate the pleura, keep up inflammatory change, and do not promote the return to the normal state. In cases where the solid masses are too abundant to be evacuated by ordinary paracentesis and appear to be the cause of irritation, the major operation must be undertaken, as also when the fluid withdrawn is offensive.

Southey's Trochars are too delicate and fragile instruments, and too easily broken to use in tapping the chest. They must remain a long period in the chest, and there is then the danger that a fistulous opening, with consequent conversion of the effusion into an empyema will result. Such an event indeed occurred in a case operated upon by Dr. Southey. Dr. Goodhart* recommends capillary drainage, but some more reliable instrument than Dr. Southey's must be invented for the purpose.

The Introduction of Air.—When speaking of the various modes of treating empyema, we shall refer to a plan suggested by Mr. Parker advocating the introduction of purified aseptic air to fill the place left by the pus. It is recommended where, owing to a rigid thorax, the fluid does not flow on tapping. The air expels the fluid and is ultimately absorbed. Of the harmlessness of aseptic air within the pleura there is no doubt, but the most careful precautions are apt to be defeated, and in such cases as those, for which this novel suggestion is intended, aspiration

*Goodhart. *Lancet*, Aug. 24th, 1878, p. 246.

is as effectual and less likely to convert a serous into a purulent effusion. Dr. Hicks, speaking after the reading of Mr. Parker's paper, said that the introduction of air during the performance of paracentesis had checked cough. But this can be done by the remedies and means already pointed out.

Gerhardt's Aspirator.* To avoid brusque variations in the suction power of the aspirator, a flexible tube connected with the needle should be attached to one neck of a three-necked bottle, the syringe to the second, and a mercurial manometer to the third neck. The bottle should be of three to five litres capacity, so as to distribute the pressure over as large a surface as possible. Gerhardt has succeeded in removing quite small bodies of effusion with a suction force of only thirty millimetres of mercury.

* Gerhardt, of Wurzburg, quoted in *Medical Times and Gazette*, Feb. 7, 1880, p. 152.

CHAPTER IV.

WHEN TO OPERATE.

Having made himself familiar with the best method of performing paracentesis, the intending operator must review the circumstances on account of which he may be called upon to put his acquired knowledge into practical execution, and endeavour to add to the good repute of an operation which is held in estimation at the present day. Pleuritic effusion complicates many of the affections to which flesh is heir, but if the limits of the operation be first defined in simple cases, and the indications for its employment pointed out in cases of ordinary pleuritis, the necessities which demand its performance in secondary pleurisies will be more readily appreciated.

The effusion thrown from the inflamed pleural surface may be sero-fibrinous, sero-purulent or purulent, but, as will be hereafter explained the employment of paracentesis in cases of purulent accumulation, except in certain exceptional instances, is abortive and unsatisfactory. Thus, at once, the scope of our enquiry is narrowed; but, notwithstanding, our task is not a light one.

Many circumstances influence and guide us in performing the operation, and, for convenience sake, they may be arranged into three classes, as follows:—

The local conditions in the chest.

The symptoms to which the presence of effusion gives rise.

The constitutional state and age of the patient.

In one case the local conditions may demand the operation; in another dangerous symptoms may call for its speedy performance; while in a third the depraved bodily condition of the patient may be the

indication ; but in every case, these arbitrary guides must be examined and cross-examined, collectively as well as separately, they must be pitted one against the other, that the unfavourable prognosis afforded by one may not conceal and outweigh the happy anticipations to which the other set gives rise ; so that while the precipitate rashness of an eager operator may be stayed, the watchful inaction of an over confident therapist may be roused to the necessities of his patient.

In writing it is difficult to attain precision and certainty with respect to these indications, the value of which an increasing experience can alone confirm or negative. Each case must be determined upon its own merits, and as soon as operative measures are decided upon, there must be no delay in carrying them out. It may perhaps suit the convenience of the operator to postpone his operation until the next morning ; but he must remember that ere then his patient may be dead, and that upon him will then rest the responsibility of the patient's decease. Or if the case be one in which, although indications for the performance of the operation are present, there is a loitering doubtfulness of its necessity, let the surgeon err on the side of boldness, and when the chest contains fluid obey the teaching of the aphorism

“ When in doubt
Let it out.”

LOCAL CONDITIONS.—They include

The character of the fluid.

The quantity of the fluid.

The displacement of viscera and important organs.

Character of Fluid. The exudate of a simple pleurisy may be a highly fibrinous spontaneously coagulable fluid, or may present every variation between this character and pure pus. The sero-fibrinous is the resultant of inflammatory action, the intensity of which can be estimated by the “ richness ” of the effusion, or, to speak more plainly, by the number of red blood cells it contains, and the firmness with which it clots after evacuation. It is met with in its most perfect form in

sthenic pleuritis of vigorous subjects, and usually varies in colour, from the pale yellow and golden to the deep brown or even red; not infrequently its hue is green. It is the product of acute pleurisy, and its formation is attended with the symptoms and constitutional derangement, known by the term "inflammatory fever." Pyrexia, as indicated by the thermometer, and a pungent burning skin, thirst, anorexia, scanty secretions, and even delirious wandering, are the looked-for accompaniments. Add to this group of phenomena, the physical signs of pleurisy, and our summarised description is complete. Examination of the chest reveals the presence of fluid, which, in spite of local depletion, fomentations, or limitation of the movements of the chest wall by strapping; and, notwithstanding the prompt and regular administration of aperient, diuretic, and diaphoretic drugs, increases; and as the rising line of dulness informs us, gradually creeps upwards, fills the pleura and more thoroughly squeezes the already embarrassed lung. To what extent should the effusion be permitted to progress? How high in the chest should it be allowed to reach? or by what means can we determine the proper moment at which relief should be afforded to the oppressed lung?

When treating of hæmothorax we shall relate some experiments by Trousseau, who found that the healthy pleura possessed in an ample degree the capability of quickly absorbing blood. He observed during the process that no inflammatory change took place in the pleura.

We have already pointed out the abundance of red blood cells in the effusion of an acute pleurisy, and the teachings of Trousseau's experiments would at the outset of our enquiry suggest that such effusions would be readily taken up by the pleural membrane. But inflammation has converted the previously absorbing membrane, into an active secreting; or has so stimulated the last-named power that the balance of the two is upset, and the absorption is unable to keep pace with the secretion. I am advancing no new truth when I

remind the reader that one characteristic of inflammation is exudation. As long as there is inflammation so long will exudation continue. If inflammation of the pleura gives rise to effusion, as long as inflammation persists, the tendency will be for the pleural membrane not to diminish but to add to the quantity of the already secreted fluid.

The case of Joseph Hirst (*case 38 in appendix*) illustrates my point. When he came under our care he presented all the symptoms of inflammatory fever after the continuance of a pleurisy for (at the lowest estimate) 10 weeks. Indeed, before the tapping I was of opinion that the case would prove to be one of empyema. The physical examination, revealing absolute dulness, extreme displacement of organs, and obliterated respiratory sounds prepared us to anticipate the withdrawal of a large quantity of fluid, while the pyrexia and general symptoms told of persistent acute pleurisy. The inflammation of the pleural membrane had evidently continued from the commencement of the affection, and the process of absorption had been, if not prevented, at any rate more than counterbalanced by its antagonist exudation.

As a means of conveying conviction to the reader let me ask him to predict the consequences of repeating Trousseau's experiments in the case of a pleura acutely inflamed, strict antiseptic precautions being, however, observed. The results, though hypothetical, even though the success of the antiseptic precautions be complete, would not, I imagine, be as encouraging as those of Trousseau. The blood instead of being quickly absorbed, would irritate the pleura, increase the inflammatory disturbance, that probably an empyema would result. And if the blood acts as an irritant, is the inflammatory serosity less likely to have such properties? Indeed, I believe that surgeons will have to recognise "a septicæmia," produced not by offensive pent up accumulations or putrid pus, but excited by the absorptive influence of "aseptic" inflammatory fluid. It has been my lot when an operation wound has been produced aseptically and has run a typically aseptic course,

frequently to observe that whilst the thermometer did not register more than the normal, or more than one degree above the normal, standard, the pulse rate was maintained at 100 per minute until the exuded serum had ceased to be thrown out or had been absorbed. Especially has this discrepancy struck me in cases of excision of the mamma.

Returning from this digression we have to observe that an acute pleurisy may be arrested, inflammation subside, exudation cease, and absorption take place, without the necessity for paracentesis. Case 33 in the appendix is an example. But should this desirable cessation of acute symptoms not take place, when should the aid of paracentesis be invoked? Some authorities arbitrarily fix a certain day of the disease, such as the 10th or 21st, before which they recommend operative measures to be stayed, but it is not only a matter of reasonable logic, but a result of experience, that what in one case at the end of a given time is absolute urgency, in another is comfortable security.

Again, others are guided by the quantity of fluid that fills the pleura; but, although more reliance can be placed upon this indication than upon that last mentioned, the quantity of fluid which can be borne with impunity by one patient, would set up dangerous symptoms in another. If we are called to a case of acute pleurisy, and find the pleura full, we must tap at once. Again, if we have charge of a case, and the fluid be increasing, we must never allow it to fill the cavity. If the level of the fluid reach the middle of the scapula, and give rise to no urgent symptoms, we may stay our hand, watching jealously, however, for its fall or rise, and in the latter case, especially if there is evidence of continued inflammation, it should be our duty at once to tap. The fear of injuring an inflamed pleura, is almost groundless, and the risk had better be incurred, rather than that the patient should succumb from suffocation or exhaustion. Dr. Martin,* of America,

*Martin. *British Medical Journal*, vol. 2, 1881, p. 391.

has shown that the danger of puncturing the serous cavities of inflamed joints is less formidable than our predecessors believed, and my original notes of a case which was treated in the Huddersfield Infirmary will confirm Dr. Martin's statements.

J. G., a silk dresser, æt. 38, presented himself at Mr. Knaggs' out-patient room, having a swollen knee. He said that nine days ago, he knocked his knee against a projecting wheel, but feeling only temporary pain, he continued to move about as usual. On the next day, he had much pain in the knee, shooting up and down the leg, and in three days afterwards the knee was observed to be swollen.

On Examination—The right knee was puffed out by a large soft swelling, the outline of the patella being imperceptible to the touch. The joint was hot, and there was tenderness on pressure or movement. He was advised to come into the hospital, and on the next day, Sept. 23rd, 1881, he was admitted.

He was put to bed, extension upon the leg used, and immobility of the joint secured and maintained by a back splint. To the joint itself cold lotion was applied; but no perceptible improvement taking place it was decided to aspirate the joint. This was done with antiseptic precautions on Sept. 29th, and four fluid ounces of flocculent slightly turbid serum were withdrawn. The swelling had disappeared after the aspiration, and the previously tense joint was apparently near its normal size, the skin in front of it being rather loose. The limb being still on the splint, a porous india-rubber bandage was wound with considerable compressing force round the limb, beginning just below the tubercle of the tibia and ending near the middle of the thigh. Since his admission the patient had required an anodyne at night, which was given on the evening of the aspiration.

Sept. 30th.—Bandage re-applied, rather slacker than before. The "knee-pain" has been much less severe, and he says he has passed the most comfortable night since admission.

Oct. 3rd.—Improvement continues. Has slept without morphia for last three nights, and there is a distinct diminution in the quantity of effusion in the joint, which has again swollen to half the size it first reached.

6th.—The patella is quite perceptible, both to the sight and touch. The temperature, which, before the aspiration, reached 101° each evening, has gradually fallen to the normal height.

7th.—Extension of leg discontinued.

10th.—Bandage discontinued, and the knee was strapped.

12th.—Patient got up.

14th.—Discharged.

Remarks.—The above treatment recommended by Dr. Martin, of America, has, in a fortnight's time, restored the acutely inflamed joint of a labouring man to a condition not far from that of the normal and healthy. There was no exercise of patience, whilst the inflammatory symptoms subsided under the use of evaporants and such like; no painting with iodine nor irritation by blisters, cauteries, or issues; no thickening or adhesions left in the joint requiring months to become consolidated or absorbed; no after stiffness nor lameness; but an useful, comfortable limb, enabling the patient to return to his occupation without long delay. The painlessness of the aspiration is also a feature of importance.

But the object of early evacuation of the fluid of an acute pleurisy is to prevent the formation of those adhesions, and false membranes, which, deposited upon the pulmonary pleura, are a hindrance and a bar to the after expansion of the lung. If the fluid be evacuated we take out from the pleura in a liquid form the material from which the adhesions are produced, the pressure and tension within the pleura is relieved, the lung is in a condition capable of expansion, absorption will probably set in, and the case "clear up"; or if more fluid be poured out its bulk will not equal that of the portion evacuated, and should the symptoms persist, and increase of the fluid continue another tapping can

be safely performed. The height to which the thermometer shows that the temperature rises should not deter us from operating ; for an increasing effusion with pyrexial accompaniment proves that excessive exudation is proceeding and that the overburdened pleura demands relief.

Again if the recently effused accumulation fill more than half the pleural cavity, if it remain stationary, as regards either increase or decrease ; if persistent pyrexial symptoms remain, our aid must be given. A week may be allowed to elapse, if no symptoms of urgency are present, and if the patient is placed in circumstances tolerably favourable for treatment ; but if, after the judicious use of constitutional and local remedies, no diminution of the fluid have resulted, it will then be our duty to tap the pleura.

The text which has served for the foregoing remarks has been the character of the fluid, and as our sermon upon this division of our subject is not yet preached, we hasten to take up the consideration of the next head. The fluid we have described has been that of an acute pleurisy, and we have hitherto presumed that it has been completely absorbed by means of medical treatment or operative measures. In many cases this happy result will be attained, but in a certain proportion of the cases—especially if paracentesis be too long delayed—the fluid will lose its “acute” characters, and possess properties somewhat as follows: It will be more limpid, less prone to coagulate ; the rich golden colour will not be so marked or may have changed to a clear, opalescent, or turbid yellow or grey ; floating flocculi may be visible to the naked eye and altered leucocytes, by the aid of the microscope, whilst the red blood discs will be less abundant. It must be observed that these changes have taken place whilst the fluid was yet in the cavity of the pleura, and we shall find on examination that the pleura bears marks and indications accounting for the altered nature of the liquid. Before the pleuritis had begun the serous membrane was smooth and shining ; during the acute stage a thin coating of lymph dulled its surface,

and after this has passed, shaggy masses of fibrinous deposit separate from the fluid, cover the membrane, and hardening and thickening by fresh deposit every day, at length convert the once thin and delicate tissue into a tough leathery case, in which calcareous particles may ultimately develop. The fluid lymph of the acute effusion has become flocculent, and depositing itself then upon the pleural surface, has formed false membrane. This, then, is the phenomenon, which is the clue to the alteration in the fluid.

In another class of cases, fluid possessing characters, though in a minor degree, similar to those I have related is often drawn away, when apparently no evidence that an acute inflammation has occurred in the pleura, can be obtained. Such are the cases spoken of as "latent pleurisies." The consideration of this class of fluid thus brings two groups of cases under our notice, viz.—

The chronic pleurisies.

The latent pleurisies.

But it will be necessary to allude to the influence which the false membrane formed within the pleural cavity exerts, upon the parts concerned and consequently also upon our treatment.

Fluid or air within the pleura occupies a portion of the space normally filled by the lung. The lung being pressed upon is gradually driven to one side of the cavity, most usually to that part of the posterior surface adjacent to the spine, which has been indicated when speaking of the thorax (*see p. 6*). But if a previous pleurisy have caused lymph to be thrown from corresponding points of its pulmonary and parietal layers, adhesions may confine the lung to that part of the chest wall, and prevent its retreat into the posterior *cul de sac*. The lung squeezed by a power so subtle that all its vesicular structure is obliterated, until, perhaps, a dense carnified slab represents the once expansile and crepitant organ, its surface bathed in the surrounding effusion, acquires its share of the soft lymph, which is being deposited or thrown out in all parts of the pleura. The covering thickens and hardens daily, and

at length its resistance and strength are such that when the lung is placed under circumstances otherwise favourable for expansion—as when for instance, the fluid is removed by operation—it can overcome and break through this limiting membrane, with difficulty, perhaps incompletely, or not at all. If an attempt be made, in a fatal case, to artificially expand a lung thus bound down, it will not be successful until the adventitious membrane is removed, when it can be readily effected; as was shown in the post mortem room by Dr. Wilks, who in a case of pleurisy of six weeks duration, was unable by means of bellows to expand the lung until the pulmonary deposit had been dissected off.*

Occasionally instances of simple mechanical or inflammatory pressure on the lung are seen. Such are the cases of simple pneumo-thorax, and in them although the lung may have been for a considerable period reduced to a useless piece of tissue, on its liberation from the compression it has at once expanded. There has been no imprisonment by a membranous layer—no hindrance to expansive tendency.

I have termed the compressing power of the pleural effusion upon the lung a subtle one. On handling a healthy lung the peculiar sensation called crepitation is felt. It is produced by air within the pulmonary vesicles, and to those who have not attempted the task, the difficulty and, save under very extraordinary circumstances, even impossibility, of destroying that crepitant property will be inconceivable. We may squeeze the lung, or stamp and jump upon it without expelling much of the air it contains; and our efforts will be surpassed by the quietly working, equable, and gradually increasing force of a volume of liquid in the human frame, possessing no power but that of a pathological perversion. We are accustomed to recognize the fact of lung compression, but are not so ready to appreciate the subtilty of the power necessary for its production.

* *Lancet.* Dec. 14, 1872, p. 848.

Recurring to the results of the formation of false membrane, this may be beneficial by causing adhesion between the pulmonary and costal pleura, preventing collapse of the lung as effectually as it more frequently interferes with expansion.

Bearing in mind the conclusions inevitably deduced from these facts the value of the recommendations for tapping the excessive exudation of an acute pleurisy is enhanced, and we must ever remember that however early we tap a certain amount of false membrane will have formed. It must, however, be our aim to tap before the lung has been unduly pressed, and before the flocculent lymph shall have become leathery bands; for the lung which has been displaced by half a pleura full of fluid, is in much more favourable circumstances for breaking through the false membranes than one struggling under the incubus of the completely distended cavity; indeed, in the former case it may be compared to a man carrying a weight, which is almost as heavy as he can bear, whilst in the latter it completely overpowers him, and leaves its ill effects upon him for years afterwards. And when we remember that the force of expiration is more powerful than that of inspiration (*see page 14*), we have another argument to add to those adduced for not allowing compression of the lung to reach an extreme point; and, as in the case of the inflamed knee, recorded at page 68, by tapping there were, "No thickening or adhesions left in the joint, requiring months to become consolidated or absorbed; no after-stiffness nor lameness; but an useful, comfortable limb, enabling the patient to return to his occupation without long delay." So should it be our aim to promote a return of the chest to its former state of vigour and usefulness.

Nor are the effects of the false membranous layer altogether mechanical, as the absorbent function of the pleura is more or less destroyed by the alteration of its serous surface. In cases of considerable duration the effusion appears to remain stationary, while from the tolerance of the individual it exerts comparatively

little influence upon him. When, in addition, the pleura is distended, the pressure upon its sides must compress the vessels, and damage, if not annihilate, their absorbent function.

It is in cases of pleuritic effusion becoming chronic after an acute attack that the presence of false membrane is to be especially suspected, and we may include as aids in enabling us to answer the question when should tapping be undertaken, the influence of the quantity of fluid present, and the extent of the displacement of important viscera or organs.

Should the quantity of effusion be small, reaching as high as the angle of the scapula, no operation should be performed, unless after a month's medical treatment no diminution in the bulk occur. Supposing, however, that the chest be full, the lung squeezed, that the heart is displaced or the diaphragm pressed down, although no subjective symptoms are present, I should tap at once, but if no displacement of organs is present a week's trial of remedies is permissible. But supposing that the fluid of a small effusion, instead of slowly disappearing, gradually rises, and it is remarkable with what insignificant symptoms this may be associated, when should aid be invoked? Presuming that no dangerous accompaniments are present, if the fluid reach the level of the middle of the scapula, and still shows upward tendency, it is our duty to tap. Again, if a case comes to our notice, and examination shows that the middle of the scapula registers the height of the effusion, if after waiting, not more than seven days, the fluid do not diminish, we must tap; and if its tendency is an increasing one we must evacuate as soon as the fact is discovered. It is to be borne in mind that dulness, as a sign of diminution of fluid, although of value, is by no means so delicate a test as increasing distinctness and "nearness" of respiratory sounds in the lung of the affected side. This fact was impressed upon me by the case of the lad related hereafter, where before any appreciable diminution of dulness had set in, considerable increase of the intensity of the respiratory sounds occurred. The converse proposition—that

the volume of the fluid is no gauge of the compression of the lung—is also conceivable, and has led some to adopt a more reliable and scientific test of the capacity of the lung. This is obtained by the use of the spirometer, concerning which one of its advocates* observes :

“ It gives information concerning the ebb and flow of fluid in the chest. If the vital capacity steadily increases, if each succeeding week the lungs admit an augmented volume of air, it is our duty to avoid all operative interference. But if the vital capacity of the chest is diminishing or remaining stationary, paracentesis can no longer be prudently delayed.”

In those cases where symptoms are absent, where the line of dulness remains stationary, where we are in doubt as to the propriety of the operation the spirometer is likely to be useful, and may, perhaps, by indicating diminished vital capacity from the hindrance to the lung by the increasing power of slowly strengthening false membrane, in a case of stationary effusion determine the time of our operation. Likewise, in cases of more considerable effusion, seen for the first time without any data of the previous treatment to guide us, the increasing vital capacity would postpone, if not prevent, our operation. Should such a case come before us, even though the spirometer be not available, if there be no dangerous symptoms, no displaced organs, we ought to wait seven days before tapping. This class of cases, however, is more often met with among the “latent pleurisies,” or, borrowing a term frequently employed when speaking of abscesses, *the cold pleurisies*. Cases 12, 20, 26, 26a, 28, 31, 34, and 35 in the appendix serve to illustrate the clinical history of these cases, which is usually that the patient has been conscious of some shortness of breath on exertion, general weakness, and malaise for a few weeks, but has continued to follow his occupation until a day or two before seeking advice. On examining the chest,

* Morgan. *Lancet*, Feb. 27, 1881, p. 324,

fluid is discovered, and the most usual event is that one pleura is found full. A considerable experience of these cases has shown me that they rarely absorb unaided, and if the pleura be full, I advise that tapping be performed after a couple of days' rest in bed; or immediately, should urgent symptoms be present. These patients are generally anæmic, and have gone about their avocations with a full pleura, which, while it has not induced alarming symptoms, has preyed upon the constitution, destroyed appetite, produced emaciation, and reduced any power of absorbing the fluid the system, and consequently the pleura, possessed. If the fluid do not half fill the cavity of the pleura, the operation may wait, good food and wine being given, and careful examination of the chest made for phthisis, for, as I have already observed, the pleura is usually found full.

There is a class of cases (see cases 23, 30, 32, and 33 in appendix) not so acute as those for which my description has thus far been intended, nor so chronic nor latent as those I have last alluded to. They commence with a pleurisy, not so intense as the typically acute pleurisy, and which becomes chronic more quickly. Our operative measures in these cases must be guided and controlled by the rules already laid down.

The displacement of organs is a spur to our apathy, and must never be permitted to continue long, although in the early stage of acute effusions it may be more marked than in a large slowly formed accumulation. In the latter cases therefore it must be remedied by removal of fluid without delay, and in the former an increasing effusion will warn us of the dangers we are incurring.

Cases occur, where, although the chest be absolutely dull, only a small quantity of effusion exists. In such cases the expanded lung is surrounded by a layer of fluid, and no operative interference will be needed. These cases will be referred to again when discussing the conjoint occurrence of pleuritic effusion and pneumonia.

Symptoms to which the Effusion may give rise. It must

be observed that a small recently formed effusion may give rise to more urgent symptoms, than a large one, which the pleura and surrounding viscera have learnt to tolerate. At the early stage of an acutely formed effusion dyspnoea may be present, cyanosis commencing, and unpleasant, but not as a rule dangerous, symptoms, which will disappear as the quantity of the effusion increases, occur. At this stage tapping would add an additional element of danger to the case, and cannot be so safely performed as when a large accumulation forces the lung from the reach of the trocar. Opiates, and local warmth are the usually sufficient remedies for such symptoms at this stage of the complaint. But at a later stage of the effusion symptoms calling for prompt measures may arise. These include syncope, embarrassed respiration, suffocative paroxysms, embolism and "sudden death." Although I take up my pen to treat of these accidents I must at once confess that excepting the complication of embarrassed breathing, usual in acute cases, I have not met with any of them, and am inclined to agree with Gairdner, who, writing when paracentesis was not often performed, says he has not found these accidents to be as numerous as Trousseau has affirmed that they are, and he accounts for the frequency of syncope in Trousseau's cases by the too vigorous employment of lowering and depletory measures* There can be no doubt that those of our forefathers, who 50 years ago were bold enough to puncture the chest, refrained from doing so until some indication of danger to life appeared; and their cases were allowed to drift into a desperate condition. Then, and not till then, was the forlorn hope of paracentesis entertained.

At the present day, thanks, undoubtedly, to the enthusiastic advocacy of Trousseau, we endeavour to anticipate and avert those grave events for which our predecessors waited. We do not admire the conduct of him who, seeing his friend struggling in deep water,

* Gairdner. Clinical Medicine.

will not throw out his life buoy until the drowning man has risen, almost exhausted, for the last time ; and the performance of paracentesis, when the powers of life are overwhelmed, is offering to the sufferer the drowning man's straw, as compared with the timely rendered aid of an earlier operation. As long as the lung, like a bather unable to swim, keeps in shallow water, comparative safety is assured ; although "cramps," which the accidents we are considering may be figuratively termed, may even then occur ; but when in deep water, immediate aid is necessary, and should never be withheld, either from the drowning man or the over-burdened lung. It is to prevent these "cramps" and accidents that the rules laid down in the preceding section have been formulated, with the hope that paracentesis thoracis may take its place in the armamentarium of Preventive Medicine.* Should syncope occur in a case of moderate effusion, it should be an indication for tapping ; paroxysms of dyspnœa or severe oppression of breathing should act as an equal stimulus to us. We are not treating an unchangeable definite structure. No two patients have the same constitutional peculiarities, the same power to withstand disease or the same toleration of fluid in the chest. *Experientia docet* is a motto whose truth time will demonstrate to the operator, who will learn to recognise when difficulty of breathing should be relieved by paracentesis ; but in otherwise uncomplicated cases the sudden accession of any of the symptoms enumerated should be regarded as an immediate indication for tapping.

Lastly, if the patient be losing flesh, suffers from general malaise, feeble circulation, irregular pulse with tendency to syncope, dyspeptic trouble, for which no cause but the presence of a quantity of fluid in the pleura can be assigned, there should be no hesitation in performing the operation, although the patient may not complain of local trouble in the chest.

*I am aware that paracentesis is a surgical procedure ; but it is the duty of the physician to determine when it shall be practised. It is, therefore, the physician's remedy.

Age and Constitution of the Patient. In infants the occurrence of pleuritic serous inflammatory effusion is a curiosity, although not an impossibility, as West and others affirm. Dr. Cayley has recorded the successful aspiration of a serous accumulation from the chest of a child one month old.* The fluid is almost invariably purulent, however, and I have never yet met with a case of serous accumulation in a child. Whether the pus is primarily secreted by the pleura or results from the rapid conversion of a serous to a purulent effusion, does not appear to have been determined. But the lesson to be drawn from the knowledge of the fact that inflammatory disturbance in the young is apt to be intense, is that abundant outpouring of effusion, either of a purulent or serous character may rapidly ensue. Not only may the accumulation be rapid, but also insidious, and during some of the exanthemata and the pleuropneumonia of children, its occurrence may be overlooked, and the attendant may assume that rapidity of breathing is but one of the general symptoms of the febrile state. In such cases an examination of the chest should not be neglected if the respirations be much accelerated or interfered with, and if the signs of fluid are apparently present, they should be confirmed or negatived by the exploratory syringe. The rise and fall of the fluid must be carefully watched, and if it fill the chest and difficulty of breathing be prominent, aspiration must be performed, if the child be not more than three years of age, whether the effusion be of a serous or purulent character, the acute febrile symptoms still remaining. If the acute symptoms have subsided, and pus remain in the pleura, if the child be above two years of age, the chest must be incised, and if under that age aspiration may be practised. Writers, referring to the rapid formation of fluid in children and youths, generally recommend early recourse to paracentesis; but it has appeared to me that they overlook the inherent capacity of the vigorous constitution of the youthful frame to repair damage.

**Lancet*, December 7, 1878, p. 806.

Surgeons are familiar with the fact that they may in their primary amputations for injury leave much more injured tissue and integument to form the stump in the case of the young, than in the adult, and I venture to advance the same practice with regard to paracentesis. As the inflammation is usually more intense, so is the curative process more complete and powerful. By pushing in the trocar, and leaving it in the pleura during the period necessary for an aspiration or paracentesis, we are complicating every case of Intra-thoracic Effusion by a new, and to some extent dangerous element. It should, therefore, be our endeavour, while not delaying the operation too long, not to perform it needlessly. Our cases should be watched jealously, our patient's chests regularly examined, and weighing and considering the general symptoms, we must determine the operation after due deliberation. If the case be not an empyema, I deprecate hasty operative measures in the young. Even if the pleura be full and acute symptoms have subsided, absorption can very often be secured by counter-irritants or general remedies.

There is a type of patients, in whom pleuritic effusion appears to be common, and who rarely need paracentesis. They are youths of from 12 to 17 years of age, who have often been exposed to vicissitudes of weather and rough living. A history of febrile disturbance and pain in the side at some not very distant date is usually obtained, although the patients complain at the time of seeking advice of no specific ailment, are free from febrile disturbance, but bear pallid faces and are poor eaters. One side of the chest is found more or less filled with fluid.

The case of Thomas Murphy, aged 15, admitted into the Huddersfield Infirmary on June 4th, under the care of Mr. Robinson, the senior surgeon, a man ripe with the experience of 42 years, is an example. The left side of the chest was filled with fluid, and there was slight displacement of the heart's apex beat to the right. There was no evident distress, the breathing, though almost entirely carried on by the right lung, was easy, and a faint respiratory murmur close to the

left side of the spine indicated the situation of the lung of that side. I myself was only prevented from inserting a trocar by the controlling hand of Mr. Robinson, who instead of evacuating the fluid, placed the patient upon a liberal diet, prescribed the administration of the Citrate of Iron and Quinine, and Cod Liver Oil, and ordered the local application of Iodine to the chest wall. The temperature, which, on admission of the patient reached 100° each evening, soon fell to the normal standard, and on August 10th the boy was discharged, the lung having completely expanded, comparative dulness of the affected side of the chest alone remaining. Three more cases occurring in boys of the respective ages of 12, 13 and 14, and resembling that of Thomas Murphy in all particulars, save that the quantity of fluid was not so great, were also admitted to the Huddersfield Infirmary during my house-surgeoncy, and in all, the fluid absorbed under the influence of good diet, ferruginous tonics and the local application of Iodine. It is also worth noting that the ages of the patients whose cases are related in the appendix, where the expectant treatment was successful, were 18, 11, 16 and 18 years (cases 13, 26, 30 and 33).

We have no more powerful ally than youth, and during the early period of life a more extended trial of drugs may be made before resorting to an operation than in the case of older patients. Even though the pleura be full; even though some displacement of organs be present; and presuming that dyspnœa be absent, that the breathing is not embarrassed, that rest in bed is maintained, and reasonable care observed by the patient, a *bonâ-fidê* attempt to procure absorption with remedies should be made. In the case of those who come from the slums of our towns, who have been fed on tea and pork butchers' delicacies and compelled to suffer either the evil effects of moving up and down or the more prejudicial influence exerted by the impure atmosphere and deplorable hygienic condition of their habitations, and deprived of attentions so effectual in restoring the sick to health, residence in a well-appointed hospital will

prove of the utmost benefit. The improved atmosphere, the more generous diet, and the complete repose thus secured are among the most valuable of our aids in promoting absorption of a pleuritic effusion. It should be our aim, especially in hospital practice, to discover the previous surroundings and conditions of life of each patient. If he or she have been treated *secundum artem*, without deprivation of the necessities of life, with thus far negative result, our operation will be the more called for, *cæteris paribus*, than in the case of those rescued, as it were, from the double incubus of a pleuritic effusion and prejudicial surroundings. This observation applies to the cases of adults, as well as those of youths, although not with the same force; and while, therefore, we do not allow the operation to sink into the background of a last resource, let us not be too eager to consider it a "first aid." As life advances the vital processes become less active, and the recuperative power less, and in the case of patients above 30 years of age, paracentesis should be more prominently kept before us, lest by too long delay the compressed lung, not possessing the vital freshness of the younger subject, be too bound down to recover.

While we make adequate allowance for the altered or improved circumstances of a patient newly placed under our care, we must be careful that we do not confuse the result of unfavourable surroundings with the marks of a depraved constitution; nor must we mistake the latter for actual disease, which may accompany the effusion. As an example of a depraved constitutional state, I may instance the well-known appearance of the premature old man, brought on possibly by irregular living, anxiety, and losses in business, or free indulgence in alcoholic liquors. This state may complicate the case of a millionaire as well as that of a beggar, and although in both the difficulty is to determine where a broken-down constitution ends and actual disease commences, yet the type which I have instanced will at once be illustrated by examples which have come within the reader's observation. Such cases call for early and prompt interference. The

capacity of the individual to withstand disease of any nature is diminished, and his ability to check the formation or hasten the absorption of a pleuritic effusion is correspondingly impaired. We should not therefore wait until the pleura fills, but as soon as we have evidence of an increasing effusion having reached the level of the middle of the scapula, we must proceed to operate.

SECONDARY PLEURISIES.

Turning now to the consideration of the complications of pleurisy and the diseases of which it is an additional feature, we shall find the rules for operation modified. Bowditch,* when discussing the indications for the operation observes that "no amount or character of complications of disease, either cephalic, thoracic, or abdominal, prevents me from operating when I find a large effusion, or any effusion that is adding distress to a patient already very ill. In some such cases I operate simply to give relief. I do so as freely as I would use a subcutaneous injection of morphine, prescribe a blister or cathartic." Let us consider the thoracic complications, of which, those resulting from inflammation of contiguous organs or structures are the most frequent. During

PNEUMONIA—

as evidenced by the *post-mortem* examinations of fatal cases—a certain quantity of pleuritic fluid is usually formed, and it occasionally happens during life that signs of fluid in quantity mask those of the pulmonary lesion. Such is case 13 in the appendix. During the acute stage of the disorder no operative procedure must be entertained, as the solidifying lung, acts as an efficient preventive of compression to a small size, and by spreading out the fluid in a thin layer around it may produce the signs of a full pleura. But when the acute stage is over, careful examination should

* Practitioner, vol. I., 1873, p. 194, *et sequent.*

invariably be made, lest any fluid remain behind. Usually it will have been absorbed, but I believe that the number of cases of pleuritic effusion after so-called sthenic pneumonia, is greater than is generally recognized. I have met with two well marked cases, one occurring in a woman, of feeble powers, aged about 50, the other in a man, aged 28, besides making a *post-mortem* examination on another who died during the acute stage of pneumonia, when nearly a pint of effusion was found. I had also a serious, though friendly difference with one of the physicians to the Huddersfield Infirmary regarding the physical condition of a woman's chest, I believing the case to be one of acute pleurisy, whilst my senior affirmed that when he sent the case into hospital it was one of pneumonia. Indeed, it is difficult in a case of acute pleurisy to determine whether pneumonia complicates the case. If after the acute symptoms have disappeared, fluid remain, it must be treated according to the rules already laid down, good diet, fresh air, and tonics being always regarded as valuable aids to any other treatment.

CONGESTION OF THE LUNG.

Instead of an inflamed, there may be a congested lung, and it is rarely that operation is called for in such case, as an increasing effusion drives out the blood from the lung instead of making it hyperhæmic. According to Dr. Broadbent* "the signs indicative of a large congested lung deeply immersed in the fluid are indicative of rapid absorption," and Dr. Broadbent has seen this condition in a sufficient number of instances to enable him to predict the recovery of the patient without paracentesis, and that in a very short time "One of the first steps towards recovery," he says, "is a rather sudden disappearance of tubular breathing, and the substitution of the more ordinary signs of simple effusion; and it is probable that the congested lung has relieved itself by diffusion of serum into the pleural

* *Lancet*, Dec. 11, 1880, p. 940.

cavity, and that the amount of fluid there is actually increased."

PERICARDITIS.

This complication is one of gravity, and one also which is more frequently present in left-sided pleurisy than is generally admitted. Its occurrence is apt to be overlooked, and the dulness resulting from accumulation in the pericardial sac, being continuous with that of the pleural effusion, is not readily differentiated. When a pericardial, as well as a pleuritic effusion, is recognized there should be no delay in operating upon the latter. The removal of fluid from the pleura relieves tension, and the pericardial liquid is placed in circumstances tolerably favourable for absorption. The dangers of pericardial effusion alone, when abundant, and the embarrassment of the heart's action, if appreciated, will suffice to impress upon the tyro the increased risk the patient, whose pleura, as well as his pericardium is involved. It would be interesting to know if any pericardial effusion had been discovered in those cases in which syncope is said to have occurred, and when we bear in mind the frequency of left-sided pleurisy, we feel that there are reasonable grounds for this enquiry. By relieving the pleura, we are able to remove a greater bulk of liquid than by tapping the pericardium, and absorption is likely then to take place in both cavities.*

DOUBLE PLEURISY.

The occurrence of effusion into both pleural cavities has been regarded as diagnostic of tubercle,† but I have seen a case, which ultimately proved fatal, where no tubercle was found in any part of the body after death. The indications for paracentesis are more pronounced when both pleuræ are implicated, and,

* See case related by Clifford Allbutt. *Practitioner*, 1872, vol. II., p. 77.

† Fraentzel, quoted by T. Churton, M.D., *British Medical Journal*.
Vol. 1, 1882, p. 709.

although the operator is directed to interfere* as soon as the fluid fills a space equal to the half of both sides of the chest, he may be called upon to evacuate the fluid, by the urgency of the symptoms, before the case reaches this stage, and he should always be prepared to do so.

CARDIAC COMPLICATIONS.

When speaking of hydro-thorax we shall deal with this class of cases (*see p. 89*), and it may be here observed that if in a case of cardiac disease, with dyspnœa, fluid in the chest be detected paracentesis should be at once undertaken. Not only may the effusion complicate disease of the heart, but the evil effects of an aneurism may be heightened by the pressure of a pleural effusion upon the lung. In like manner we shall discuss renal dropsy, manifested as a pleuritic effusion, when speaking of hydro-thorax.

PHTHISIS.

Pleuritic effusion during the course of phthisis of a serofibrinous nature is not common; and a sero-purulent or purulent collection is more usually found, for the pleurisy of phthisis is usually of a limited "dry" character, terminating in the production of adhesive lymph rather than the effusion of liquid. The sero-purulent liquid if allowed to remain within the chest will become wholly converted into pus, and it will probably undergo the same change if evacuated. The effusions of phthisis are very quietly and insidiously thrown out, and may be overlooked. They are not as a rule abundant, but show no tendency to absorb, and as they add an additional element to the strain already upon the patient's system, they are best treated by paracentesis. It usually happens that an effusion in a phthisical patient is produced by the rupture of a vomica into the pleura, and thus the greater frequency of empyema is accounted for.

* Anstie. Reynold's System of Medicine, vol. III., p. 946.

TUBERCLE.

There is a "tubercular" as well as a "phthisical" pleuritic effusion. The former results from the deposition of genuine tubercle in the pleura, the latter usually from the rupture of a vomica into the pleura. The fluid in the former cases forms very rapidly, and paracentesis, though necessarily palliative, by removing the fluid, may prevent suffocation, and takes away what is acting as an irritant to the pleural sac, and encouraging the further development of tuberculous nodules. Trousseau believed that pleural accumulation on the right side was always of tubercular origin, an opinion which the experience of Bowditch, as well as myself, does not bear out. Cases 12, 18, 26A, 30, 32 and 33 are examples of right-sided effusion, and in them, as evidenced by their recovery and symptoms, no signs of tubercle presented. Cases 15 and 19, also examples of right-sided effusion, are included in the collection to illustrate the subject hydro-thorax. Cases 17, 23 and 27 may have been cases of tuberculous nature, whilst that in which the suspicion of tuberculosis was verified by a *post-mortem* examination was a case of left-sided effusion.

The observation has also been made, that double pleuritic effusion is not necessarily the result of tubercle. Latent pleurisy, Trousseau* regards as being most often an "expression of the tuberculous diathesis, and quotes a case upon which Dr. Hughes operated twice, and accomplished a cure. The patient having succumbed long afterwards under the progress of the tuberculous disease which showed itself in the other lung, it was observed at the autopsy that cicatrization of a cavity had taken place on the side first affected." But, while I do not contend that latent pleurisy may not be a part of the phenomena of general tuberculosis (to which cases I think we ought to limit the term tuberculous pleurisy) I maintain that in the great majority of instances it is not so, and no dread of

* Clinical Medicine. vol. III., p. 259,

tubercle, which may lead us to assume that our operation may be but palliative, should deter us from performing it in such cases, where experience shows that its effects are often curative. The pathology of phthisis at the time when Trousseau wrote, had not been elucidated, and pathologists then termed all endogenous pulmonary deposits, tubercular. In contradistinction to Trousseau, I would denominate latent pleurisy an expression of the so-called scrofulous diathesis, although, this comprehensive definition would not include all the cases.

CANCER.

When malignant disease evokes the flow of fluid from the pleura which it irritates, no curative measures can be hoped for, and our trocar must be used as often as the urgency of the case requires. No relief is too slight to give a patient slowly succumbing to the inevitable effects of a cancerous growth which cannot be directly attacked. The same observation applies to effusion resulting from the presence of any intra-thoracic tumours. The fluid is often bloody, and should then be examined microscopically in the hope of finding cancer cells.

PREGNANCY.

Bowditch says that "age, sex, even the existence of pregnancy I deem no importance when considering the question of thoracentesis in a severe case." It has never fallen to my lot to treat pleuritic effusion in the pregnant female, but I can conceive of no bar to the performance of paracentesis in this state. If the full term be near at hand, the diaphragm will be forced up, and our puncture had better be made higher by one or two interspaces than I have recommended.

ACUTE RHEUMATISM.

Pleurisy is one of the rarer complications or sequelæ of this affection, and it is more especially in rheumatic pleurisy that the addition of pericardial inflammation

is to be feared. Paracentesis should be performed early, in accordance with the rules already laid down.

Pleural effusion may also complicate injuries of the chest, uræmic poisoning, typhoid, typhus, and puerperal fevers, peritonitis and hepatitis. Indeed, there is no disease which can be said to be free from the onset of pleuritic effusion, as all, by lowering the state of the system, predispose it to serous inflammation. In the cases cited, examination of the chest—in which the binaural stethoscope will find convenient application—should never be omitted. We must be guided by Bowditch's rule if we find "any effusion that is adding distress to a patient already very ill."

PARACENTESIS THORACIS IN SMALL EFFUSIONS.

We have thus far treated of simple gross pleural effusion, and have yet to allude to those rarer loculated and limited effusions, which, as pathological curiosities and problems of diagnosis, are of much interest. Their detection will depend upon delicate diagnosis, and their successful treatment on an exact knowledge of their extent and size. They are best treated by the aspirator, and as they seem to have a tendency to burst into the lung, no time should be lost in evacuating them.

HYDRO-THORAX.

When from static causes general dropsy supervenes, hydro-thorax is not an infrequent concomitant of the condition. The fluid of a hydro-thorax is serous, and does not primarily owe its origin to inflammation of the pleura, although low types of pleuritic inflammation are far from uncommon in those suffering from cardiac and renal disorders. The rupture of an infarct upon the pleural surface of the lung, an exposure to cold, or the presence of renal disease each suffices to light up the inflammation, to which the pleura in these affections is disposed. The pressure of a tumour upon the venous trunks within the chest before they enter the right auricle will cause hydro-thorax, and the

dropsy, which occurs as a sequela of scarlet fever, may be singled out as a frequent cause of the affection.

The fluid besides being serous is usually found on both sides of the chest, and is not, as a rule, met with until the advanced stage of the affection of which it is an integral part, and when the anasarcaous fluid has filled the spots available for accumulation in the rest of the body. In obstructive and regurgitant mitral disease it is often the last straw which weighs down the overhandicapped life trembling in the balance. It is also often undiscovered during life, and the *post-mortem* examination may reveal to us that the urgent dyspnoea which was inducing the cyanotic state in which the patient succumbed was in a measure due to the pressure of fluid in one or both pleural sacs. It is rarely that the sufferer from mitral disease during the later stages can lie down, and nothing is easier, therefore, for the attendant, with the assistance of a colleague or nurse, to lift up the patient's shirt, percuss, and if dulness exist, auscultate the posterior aspect of each lung.

Mary Rowley was admitted to the Leeds General Infirmary, suffering from well marked mitral stenosis. She had been treated as an inpatient on several previous occasions, but returning in a worse condition, in a variable period after each discharge, she was now found to have lapsed into an almost hopeless state, and after a short revival after the first few days, was somewhat suddenly seized with more urgent dyspnoea than she presented on admission. The heart was carefully examined, the usual anasarca and pulmonary congestion were duly noted on admission, but on the renewed accession of dyspnoea, the presence of more than a pint of serum in the left pleural cavity was overlooked, as the *post-mortem* examination proved. Had this patient been relieved by the withdrawal of the pleural accumulation it is possible that life might have been prolonged, for it is astonishing to observe the powers of recovery which the cases of mitral disease possess, when placed in circumstances favourable thereto. Bowditch* relates

* Practitioner, vol. I, 1873, p. 194.

the case of "a very aged man who had had manifest cardiac disease, but who at the time I was called to him had been unable to lie down for three weeks, with general dropsy; the legs, abdomen, and left pleura being all distended. Tapping the chest and drawing off over two quarts of serum relieved all the severe symptoms, and he lived for years afterwards." Whether the origin of the fluid be inflammatory or hypostatic, our duty is to remove it, if it appear to be "adding distress to a patient already very ill." Bowditch "hopes for more than simple relief, and in those in which the progress would undoubtedly be for a fatal result unless relief can be obtained by the operation."

In the cases of renal disease with general anasarca, the help to be gained from paracentesis is not of an encouraging nor permanent nature as the pleural effusion is too often an evidence that the fatal event is near, notwithstanding all the physician's art and skill. But in the cases, classed under the term chronic Bright's disease, in which the effusion developes from a low form of inflammation, paracentesis should be undertaken early, and may prove of the utmost service and utility.

ADJUNCTS TO THE OPERATIVE MEASURES.

With the plan of treating pleuritic effusion by limited, and if necessary, repeated, paracentesis must be simultaneously included the administration of appropriate drugs, and the treatment of the patient generally as experience may suggest, or the necessities of his case require. In all stages of the affection digitalis is a valuable drug, and by increasing the urinary secretion assists the absorption of the fluid. Its effects must be closely watched, and it must never be prescribed as a matter of routine, and be used with more caution in cases of left-sided than right-sided effusion. Ten minims of the pharmacopœial tincture may be given to an adult three times a day, with twenty of the aromatic spirit of ammonia in all acute cases. In all cases the effect on the urine should be noted, and if high-coloured secretion gives place to a

more abundant secretion containing less urates, not only may we assume that the drug is acting well, but that probably absorption of the fluid has begun. In every case of effusion the quantity and state of the urine will materially assist us in forming an opinion as to the necessity of an operation, and I believe it is the more efficient action of drugs in youth than in manhood that necessitates the more frequent recourse to paracentesis in the latter period of life. If the urine increase—if it approach more to the healthy standard—we may be sure that the condition of the patient is ameliorating, and that the need for paracentesis is not so urgent. Counter irritation by blisters I have a high opinion of. In chronic cases the preparations of iron, especially the tincture of perchloride, seem to have a beneficial action in promoting absorption of the fluid; and in the young and debilitated, syrup of the iodide of iron, Easton's and Parrish's syrup, cod liver oil, and quinine will be found very useful, prescribed and varied according to the peculiarities of the case. Diuretics have been recommended at this stage of the affection, a favourite combination of some physicians being the iodide of potassium with tincture of digitalis. Dr. Gairdner thinks highly of the cream of tartar given as an electuary with treacle or honey, and its use was formerly more extensive than at the present day. In my hands the effects of the iodide of potassium and digitalis have not been encouraging, and I have not tried Dr. Gairdner's electuary. Counter irritation by repeated blisters is decidedly useful, but in feeble subjects painting the chest wall with iodine is to be preferred. Dr. Wardell* has related a mode of using this agent not generally followed, but of the greatest value. One part of the solution is diluted with seven of water. "In such strength it does not vesicate, the cuticle does not desquamate at all, and the cutaneous surface can take up more of the remedy. The half-waistcoat, consisting of two thicknesses of flannel

* *British Medical Journal*, Dec. 5, 1874, p. 705.

backed with calico, becomes saturated with the drug, and an increase of warmth is locally maintained."

In all cases repose, pure air, and good food are essential, and, in many cases, judiciously administered stimulants will assist recovery. If pleurisy supervene in the course of disease, the condition which it complicates must be treated *secundum artem*.

CHAPTER V.

THE FORMATION OF EMPYEMA FROM PLEURAL EFFUSION.

One of the most untoward events that may occur during the persistence of a pleural effusion is its change from a fibrino-serous to a purulent state. We have already enforced the necessity of excluding air from the inflamed sac, as well as pointed out that "limited paracentesis" is less likely to favour this retrogression than removal of the whole bulk of an effusion. On the other hand Trousseau advocated operative treatment lest during the time absorption by drugs was being attempted a non-purulent accumulation might be converted into a purulent. Allbutt,* writing in 1872, says that by waiting there is "a fear" lest the serofibrinous exudate may become purulent. At the present day, however, when once the indications for the paracentesis are present, the operation is performed after a much briefer trial of general remedies than when Trousseau wrote; indeed, the practice of 1882 is much in advance(?) of that of so recent a year as 1872. It is rarely that one meets with a case of empyema, whose formation has been promoted by non-removal of a previously fibrino-serous liquid. Instances of empyema occurring after paracentesis from the transformation of a non-purulent accumulation are more common.

The possibility of the primary secretion of pus is best determined by the pathologist, within whose domain, rather than within the bounds of operative surgery, it lies. But the danger that a serofibrinous effusion will become purulent if undisturbed too long requires to be determined for the guidance of the

* Allbutt. Practitioner, vol. 2, 1872, p. 77.

operator, and an analysis of the cases in the appendix may help to elucidate the question. Of the eleven cases of genuine empyema, cases 3, 4, 5, and 9 on account of their early age, and Nos. 10 and 11 on account of their origin may be left out of consideration, and of the remainder, No. 1 has a history extending from Dec., 1879 to Feb., 1880, and No. 7 speaks of an illness of 9 months' duration, although the period at which the effusion formed cannot be certainly stated, while cases 2 and 6 were ill but 6 weeks before admission, and case 8 only 17 days. In the three latter cases, it would not be unwarrantable to assume that no preliminary non-purulent formation occurred, thus leaving but two cases in which this event may have preceded the deposition of pus. In children, the rapid formation of pus is notorious, and a well-known hospital surgeon has informed me of the following case—which illustrates rapid exudation in adults—An elderly person came under his care with cancerous stricture of the œsophagus. Gastrostomy being rejected by the patient she was directed to attend periodically, that by the bougie, the passage might be kept patent as long as possible. On one occasion the bougie, in passing was felt to slip, after meeting with some obstruction, and although the manipulations had been very gentle, it was thought desirable, on account of unusual pain complained of by the patient, to despatch her at once in a cab to the hospital. She died in 36 hours, and on *post-mortem* examination it was found that the bougie had penetrated one of the pleural cavities, which was distended with thick pus. It may be urged that this case is one of traumatic pleurisy, and cannot be placed in the same category with cases of “idiopathic” empyema. But it very emphatically proves that the pleura possesses the power of very rapidly secreting pure pus, and when we bear in mind the prolonged history of many cases of sero-fibrinous collections, we must allow that their spontaneous change to the purulent state is not very frequent. However, we must bear in mind that the movements of the chest favour the transformation, as

possibly, does the tension within the chest, but lowered vitality, unhealthy constitution, and inter-current disease are more potent agents, in effecting the change, and should induce us not to delay the operation too long.

If the fluid, after paracentesis turn to pus, the case must then be treated as an empyema, and, moreover, with as little delay as possible, as the treatment of such degenerated fibrino-serous effusions is as unsatisfactory as of any form of empyema. The fluid instead of turning to pus, often becomes sero-purulent, and acquires a hideously offensive odour, especially if air has been admitted. It must then be treated as an empyema. I have endeavoured to give such instructions as will prevent this termination, the points on which I lay special stress, being non-admission of air, limited aspiration and cleanliness. The cases of the appendix teach that success has attended our efforts, and one precaution may yet be mentioned, namely, to place the trocar and canula (previously cleaned) in a test tube of boiling water, prior to making the puncture.

The development of phthisis and tubercle during the course of sero-fibrinous effusion is an event which proves, either the culpable negligence of the attendant, or the extreme constitutional susceptibility of the patient, and at the present day it is, I believe, unusual to find a case where from non-performance of the operation, tubercle has developed or phthisis set in. There is much more fear that one of these affections may complicate an empyema. The rarity of tubercle in a lung compressed by fluid has been frequently remarked.

DIAGNOSIS OF EMPYEMA.

Before we operate on an empyema it is essential that we should have accurately determined the nature of the case, and we may here profitably point out that there is one reliable means of accomplishing this, viz., by the use of a small exploring syringe. The instrument must be about twice the size of an ordinary hypodermic injection syringe, the calibre of the needle about half

that of the trocar recommended for paracentesis (*see p. 21*) the point sharp, and the whole instrument surgically clean and in good working order. The needle is pushed into the chest at some convenient spot, in the same manner recommended in tapping, and as soon as the sensation felt by the hand proves that the cavity has been entered the piston is worked. If no fluid, or only a little blood, flow into the barrel of the syringe, a trial must be made at another point, and it is not unusual for a second puncture to succeed. I believe that the best spot to puncture is the 9th space and a little outside the angle of the scapula, as the fluid gravitates usually to the back. If the fluid be serous, unless symptoms be urgent, or the quantity of fluid excessive, we should not be too anxious to evacuate more fully, as by the release of tension within the pleura by the withdrawal of a drachm or two, absorption of the fluid may commence. I have never seen injury done by or harm result from the use of the exploring syringe. The little operation requires to be performed quickly, the insertion of the needle, traction of the piston, and withdrawal of the instrument, should follow each other very rapidly, and together should not occupy more than half a minute.

Not long ago a child five years of age was under my care, suffering from an inflammatory thoracic affection after measles. The rapid breathing, high fever and general distress led me to percuss the chest, and I found complete dulness on the right side of the lower $\frac{2}{3}$ rds of the posterior aspect with diminished breath sounds on auscultation. Fearing that there was fluid from the diminished intensity of the respiratory sounds—a sign in the case of the pleural effusions of children not unfrequently absent—I inserted the needle of an aspirator. Its point at once impinged upon the lung which tilted the instrument lengthways upon the surface of the chest at each respiration, and no fluid could be drawn into the vacuum of the aspirator, although a few sanguineous bubbles showed the perviousness of the needle. No aggravation of symptoms occurred after the exploration, and the child made a good recovery.

The aspirator answers all the purposes of the expla-

tory syringe, and in the case of children and where its use is otherwise indicated, it should be employed, that the necessity for two punctures may be avoided.

A short time ago the advantages of the exploring syringe were once more impressed upon me in the case of a man who was admitted into the Huddersfield Infirmary with signs of a small accumulation of fluid at the base of the right chest. There was some reason from the history to suspect phthisis, but if present its signs were masked by the presence of the fluid. He was placed in the medical ward, and three days after his admission he commenced to spit up muco-purulent matter, so offensive that it became necessary to remove him to a separate ward, and attended with so many urgent symptoms that it was feared that the case was one of inflammation of the lung ending in gangrene. The signs of fluid had now disappeared, prostration of strength became marked, and the physical signs were confined to indefinite dullness at the right base and coarse moist râles over the whole of the right lung. An exploratory puncture was made in the axilla with negative result, but on a repetition near the angle of the scapula, where the dullness was most distinct, pus mixed with air at once filled the syringe. The case was then treated as an empyema by incision of the chest, in the hope of saving the patient, who, however, succumbed notwithstanding. In all cases the exploratory puncture should be practised, as the differentiation between a purulent and fibrino-serous accumulation can only be made by it. Such indications as alteration in the chest walls and the variations of temperature, are untrustworthy, and may exist or be absent in each class of cases. In no case of empyema have I observed the œdematous integuments of the chest wall, said by some, and especially old writers, to be pathognomic, and the single case in which it was observed, of those recorded in the appendix, is one of sero-fibrinous effusion. (*Case 31.*) With respect to rise of temperature, no safe deductions can be made from its course; in some fibrino-serous effusions, it assumes almost a hectic type, whilst in some cases of empyema, though abnormal, it presents

no range characteristic of the presence of collected pus. No modern observer has confirmed the opinion of those of our forefathers who believed that it was possible, from an examination of the excretions, to diagnose the nature of the effused fluid.

A foreign professor, 40 years ago, spoke thus to his class* "I have seen in several cases the expulsion of the morbid product take place through the intestines in the form of a serous liquid, and more rarely in that of a puriform fluid. However, this mode is not the most common. Generally, the morbid secretion goes off with the urine, the quality of which is, likewise, very different in different cases, and seems to depend upon the nature of the morbid product contained in the cavity of the thorax; where it is watery, the quantity of the urine will only be increased, while its solid constituent parts will be diminished in proportion; in other cases the urine contains great masses of mucus; in others again real pus, particularly in those cases where the pleurisy terminates by the effusion of a purulent liquid. It is even possible in a great many cases to judge from the nature of the urine of that of the effusion." I have not, by making this quotation, anticipated that anyone will give his adhesion to the "facts" it contains, but I trust it may enforce the justice of my recommendation, that a careful watch be kept over the quantity and condition of the urinary secretion in cases of pleuritic effusion in which operative interference is contemplated or has been undertaken.

Dr. Hensley has invented a new exploring aspirator, which can be used either as an aspirator or exploring syringe.

THORA-CENTESIS.

We have already taken an early opportunity of expressing the opinion (*see p 19*) that the term thora-centesis should be applied to the operation of making an opening into the chest, which shall remain patent after the operation is completed. It is an operation which has been performed from the earliest times, and

* Prof. Schonlein. *Lancet*, April 20th, 1844, p. 121.

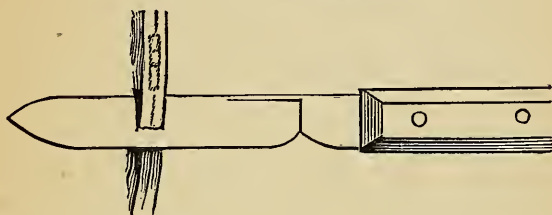
Guthrie observes* "It has not been decided whether it was first performed on Phalereus, Jason, or Prometheus; it is said, therefore, of all three that, being expected to die of an abscess of the lungs declared to be incurable, they went into battle for the purpose of getting killed; but being only run through the body, recovered, in consequence of the escape of purulent matter through the holes thus made."

The operation is simple—a scalpel, blunt-pointed curved bistoury, curved director (Lawrence's), and a couple of drainage tubes being the necessary instruments. The patient, when under the influence of an anæsthetic, supported by pillows and assistants, lies partially upon the sound side; and the skin of the patient, the instruments, and hands of all concerned in the operation having been cleansed and carbolized, the scalpel with one thrust is pushed into the pleura horizontally, through the middle of the 7th or 8th interspace, at that point of the latero-dorsal aspect of the chest previously alluded to (*see p. 13*). The director is then insinuated into the chest cavity upon the flat upper surface of the scalpel's blade, and the scalpel then removed; the groove of the director being turned away from the spine, the probe-pointed bistoury is passed along it until the cavity of the chest is reached, when with a gentle motion, the whole structures of the intercostal space are divided towards the axilla for about one inch. The pus having discharged, and having been collected in a dish, that the patient may not be wetted, the tubes are introduced, the dressings applied, and the patient, if he show signs of returning consciousness, may then be warmly covered up, and left to the care of the nurse. In not more than six hours time fresh dressings should be applied, and also once on each following day until the diminished quantity of discharge do not necessitate their renewal more frequently than each alternate or 3rd, 4th, 5th, 6th, or 7th day. In two days after the operation, one drainage tube may generally be entirely removed and the other

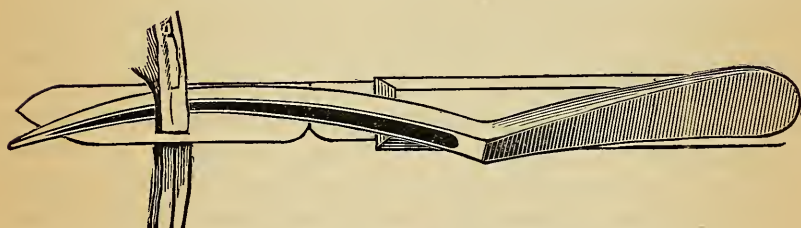
* Guthrie. Commentaries, p. 424.

shortened by about one inch, and at each subsequent dressing—according to the amount of discharge—the tube should be shortened, until at length it is finally withdrawn. The operation and change of dressings are performed with scrupulous adherence to the antiseptic principles as laid down by Mr. Lister. The accompanying diagrams will render my description clearer—

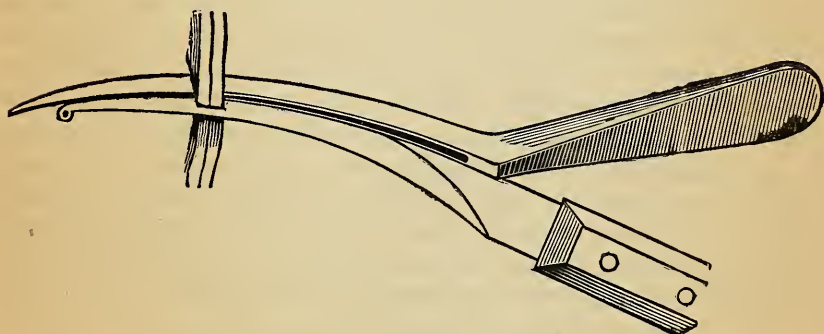
FIG. 6. THE OPERATION.



STAGE I. Introduction of Scalpel.



STAGE II. Curved director inserted on surface of Scalpel.



STAGE III. Scalpel withdrawn. Probe pointed bistoury run along director, but shown only partially ensheathed.

Before entering into a fuller account of the operation and its details, we propose to point out some of the dangers to which its performance is liable :—

Hæmorrhage :

Wounds of neighbouring organs :

Non-penetration of pleura :

Sudden death.

HÆMORRHAGE.

The incision of the thickness of the chest-wall necessarily induces hæmorrhage from the vessels then divided, but it is usually not severe, and I have never found it to call for treatment, although, as some of the blood flows into the pleura, and mingles with the pus therein, the hæmorrhage may appear more abundant than is actually the case. The danger of wounding the intercostal artery is not imaginary. During an operation upon a child, I saw considerable hæmorrhage, which made me fear that the accident had happened. The hæmorrhage was going on when the tubes were inserted and dressings applied, and although no alarming symptoms came on, the blanched face of the patient and abundance of sanguineous discharge which soaked into the dressing proved that it continued for some time afterwards. The operator must remember that the middle of the interspace is the safest ground, and in order to keep there he must cut parallel with the borders of the ribs, which in the position recommended run obliquely downwards. In extending the incision so as to admit the drainage tubes the edge of the knife should be turned away from the upper part of the intercostal space. Arterial hæmorrhage may be treated by torsion of the divided vessel, if it be within easy reach, and if from its profuseness, wounding of the intercostal artery be suspected, plugging the wound with carbolized gauze or boracic lint may be practised, being careful that a sufficient piece extrude for after withdrawal. The drainage tubes act as a plug, and compress the vessels when the arm is brought to the side.

NON-PENETRATION OF THE PLEURA.

The conditions which may prevent a trocar from

entering the pleura, act as effectively in impeding the entrance of a scalpel (*see p. 24.*) A hesitating hand, a blunt scalpel, or an altered thickened pleura may individually or collectively frustrate the surgeon's intention. The observations made when discussing this subject, in reference to paracentesis, obviate the necessity of its prolonged consideration here. In order to penetrate a thickened pleura a scalpel with a blade of medium length should be chosen, and as soon as the pleura is entered it is usual for pus to flow, but if it do not, rotation of the scalpel, so as to separate the lips of the wound, will cause it to appear. Thus, it is by this manœuvre easy to determine when the knife is within the pleural cavity, if the sensation conveyed to the hand has not previously afforded the information. It is in old empyemata that difficulty may be expected, but as early operation is now the rule, it should rarely arise, and if the incision be made at the site I recommend the risks of meeting with false membrane are less than if a lower point be selected. We shall hereafter, in speaking of the complications of empyema, refer to conditions which may prevent the completion of the operation.

WOUNDING OF NEIGHBOURING ORGANS.

Physical examination of the chest is as essential before the performance of thoracentesis as it is necessary before paracentesis is undertaken. An adherent lung will cause the operator to select another spot, of which the fifth space in the axilla or the fifth space at the interdigitation of the external oblique and serratus magnus muscles may be mentioned. I have never met with this accident, although Laennec, with characteristic candour, relates the following case*:—"The incision was made between the fifth and sixth ribs for a case of empyema, with pneumo-thorax, on a patient who had spat up a 'very great quantity' of very foetid pus. No matter flowed through the incision, although the passage of air by the wound proved the penetration of the chest by the incision. Shortly afterwards he again

*Laennec. Treatise on Diseases of the Chest, pp. 525-6.

expectorated a large quantity of extremely foetid pus, and died four hours after the operation. At the *post-mortem* examination, on puncturing the right side of the chest near the junction of the third rib with its cartilage, a large quantity of extremely foetid pus made its escape. And on making a puncture about the fourth intercostal space, a very great quantity of pus flowed out; the whole fluid in this side of the chest amounted to one and a half pints. The lung was much flattened towards the mediastinum, being only an inch thick at its superior part; it gradually enlarged downwards, and at its inferior margin was $2\frac{1}{2}$ inches in width. It was adherent anteriorly to the sterno-costal pleura. It contained cavities which communicated with the pleura. Upon removing the lungs it was evident that the side of the chest was much shorter than natural. The diaphragm was found intimately adhering to the seventh rib through two-thirds of its length, and the adhesion sloping backwards to the ninth rib, so as to leave on the lower and posterior part of the chest a *cul-de-sac* of not more than two fingers' breadth. This state of parts accounted for the result of the operation. The incision had penetrated through the diaphragm into the cavity of the abdomen, parallel with the upper surface of the liver. The liver was quite sound; between it and the diaphragm passed the incision made in operating." Laennec observes—"In the present case I attribute the adhesion to a pleurisy long antecedent to that which caused the patient's death. I have met with cases where the liver ascended as high as the fifth rib, and where the diaphragm lay in juxta-position with the pleura, all the way from its natural attachments to this point, without there being any disease of the lungs or pleura. In such cases an attack of pleurisy must have produced the extensive adhesion described."

When the pleura contains fluid, the diaphragm is, as a rule, depressed by it to a position of safety below that of the incision. After the chest is opened, and the fluid commences to pour out, the diaphragm rises to or even beyond its natural level; and in an ordinary case there is more danger of wounding it at the latter than the

earlier part of the operation. It becomes, therefore, imperative to remove the scalpel, whose sharp point and edge may wound any of the now returning viscera. The curved director should, therefore, be inserted as soon as it is apparent that the chest cavity is entered, and the bistoury, sheathed in the groove of the director, should be passed obliquely upwards. However, air will soon fill the vacuum in the chest, and the equilibrium of pressure will cause the diaphragm to descend again.

Should adhesion of the diaphragm to the chest-wall have occurred, as in Laennec's case, there is more danger of wounding it; but as the 7th space at the point recommended is above the level of the upper diaphragmatic surface, it is scarcely conceivable that it would reach so high in a chest which contained fluid. Indeed, it is the effusion itself which constitutes the element of safety in operations for its removal, and the more abundant the effusion the less is the risk of wounding surrounding structures. I have seen a case in which 6 ounces of fluid encysted at the right base had depressed the edge of the liver for $1\frac{1}{2}$ inches below the costal border. And to a cautious surgeon guided by anatomical and pathological knowledge no danger should ensue.

SUDDEN DEATH.

If we comprehend that paracentesis may suddenly terminate in death, we should not be astonished if the more formidable thoracentesis sometimes prove fatal. On examination of statistics and the reports of cases, there is reason to assume that the dangers are more to be feared during tapping than incision. I have not heard of nor seen a case where death took place as an immediate result of the operation; nor can I find reference to one in the published records, although the aspiration of an empyema has resulted fatally.* Theoretical reasons point to the admission of air which fills the place of the fluid removed, as the explanation

* Case related by M. Ernest Besnier, Paris. See *Lancet*, 7th August, 1875, p. 216.

of the comparatively greater immunity of thoracentesis, whilst the employment of an anæsthetic, by preventing pain, likewise tends to obviate syncope.

The after progress of the patient is, however, not so free from danger. Thus far, I have not referred to the practice of intra-pleural washing by warm water or medicated fluids, because I hold that there must be some special condition demanding it, and that in ordinary cases, it is a means, more potent for harm than good, either immediate or remote. In the case related by Dr. Cayley, and mentioned in a preceding chapter (*see p. 40*) washing out the chest cavity with weak solution of Iodine had been practised, and on the 10th injection, when rather a larger quantity of the fluid was forced in, alarming symptoms, ending in death, supervened. M. Vallin† reports the case of a young man, twenty-three years old, who was admitted into hospital with all the signs of pleuritic effusion, which, after remaining for a long time stationary, increased to such an extent as to necessitate paracentesis. This operation afforded marked relief; but the effusion recurring, a drainage tube was inserted, and phenic acid injections daily thrown into the pleural cavity. During one of the injections the patient complained of slight pain, and at the end of the injection was seized with fainting. His limbs became stiff, his extremities cold, his face cyanosed, and the pulse was small. After three quarters of an hour, opisthotonos came on, and 12 hours after the onset of the attack, the man died, without having returned to consciousness. At the *post-mortem* examination, nothing special was found except fatty degeneration of the heart; the head was not opened. Remarkable phenomena have been reported by M. Dumontpallier‡ to the Société de Biologie. In a case

† Gazette des hôpitaux. Transcribed in Medical Times and Gazette, vol. II., 1875, p. 664.

‡ *British Medical Journal*, Nov. 27th, 1880, p. 855. See *Ibid*, Nov. 12th, 1881, p. 774, for record of case going on well, suddenly terminating fatally during injection of the pleura. The patient had previously had epileptic fits.

of empyema treated by thoracentesis injection of the pleura with fluid, gave rise to successive crises of contraction of the right side and paralysis of the left, which rapidly passed off, and were followed by sweating and excessive lachrymal secretion. M. Lepine had previously reported hemiplegia lasting for 15 days excited by a like irritation of the pleura.

Such are some of the immediate ill effects of intrapleural injections, which although perhaps infrequent, have occurred in a sufficient number of cases to act as a check upon their indiscriminate use; for it is impossible to predicate in which patient the manifestation will arise. The pathological cause of the symptoms is apparently "nervous" or reflex, and we cannot precisely determine the susceptibility of the richly endowed neurotic element of each pleura. Bearing in mind that the sensitiveness of an inflamed structure is abnormally exalted, injections should as a matter of routine be avoided.

The intention of thoracentesis is by removal of pus to allow the inflamed membrane to regain as nearly as possible its normal state, but if, by carbolized or other irritating liquid, a regular, though intermittent irritation is kept up, the inflammatory stage will be protracted. The practice of our forefathers interdicted interference with serous cavities as an almost heinous offence; but at the present time the tendency is to overstep the opposite boundary, and to meddle with them too officiously. If good drainage be procured there is no need to wash out a serous cavity from which sweet laudable pus has been taken. An empyema has been compared to an ordinary abscess, but the analogy is only complete when the pleura is full. Who is so bold as to term suppurative peritonitis an abscess? And yet the resemblance betwixt it and an empyema is more evident than between it and an abscess. Thus the practice of hyperdistension of the pleural sac by injected fluids, so beneficially employed by Callender in the treatment of extensive abscesses, has sprung up. It is a mode of treatment to be adopted only in certain cases to be afterwards specified, and should never be applied

to the recent uncomplicated empyema. Dr. Cheadle is of opinion that injections increase the discharge, and says that he has seen more than one patient suffer from the *nimia cura medici* in this direction. Examination of the pleural cavity by the finger is also to be deprecated, unless some reason for it exist.

CONTRACTION OF THE OPENING.

After the performance of thoracentesis, coincident with the restoration of the pleural Cavity, growth along the course of the incision takes place. If the case have been treated before the lung has been so firmly bound down as to prevent its effectual expansion, the intra-pleural mischief will be repaired before a narrowing of the wound occurs. The drainage tube then prevents the tract from closing; but if unfortunately the expansion of the lung is impeded, deformity may set in, the ribs will be approximated and the tube perhaps squeezed, and free drainage interfered with. It is recommended that, should contraction of the wound channel occur, a sponge tent be pushed into it, but I have never had occasion in an uncomplicated case, where deformity has not commenced to do this, and in a case operated upon when the lung is favourably placed for expansion, I believe that it will seldom be required.

THE DRAINAGE TUBE.

It is related of a veteran commander that when asked what he esteemed the first qualification for a soldier replied "obedience"; he was then asked what quality he deemed of the next importance, and again replied "obedience"; likewise also when the question was again repeated. If I were desired to state the element most essential to the successful treatment of empyema I should reply "good drainage", and if my interrogator inquired the next most important aid, I should reiterate "good drainage." Without effectual removal of the pus thoracentesis discourages by its results, and the various methods of performing it, are but different modes of obtaining this desired end.

As soon as the purulent collection is removed the temperature falls, and the patient's general condition improves, whereas any blocking of the tubes induces fever, and the temperature rises. (*See especially, case of Wm. Smales, No. 11 in appendix.* Indeed, after a sudden elevation of temperature, when the patient has hitherto progressed favourably, our first care should be to ascertain that the tube is acting.

Various forms of drainage-tubes are recommended for use after thoracentesis, and, from personal experience, I can speak well of the efficiency of the ordinary red indiarubber one, with lateral perforations about one-third of an inch in calibre, as frequently used for the major amputations. But if drainage be secured the form of the tube becomes more a question of individual preference than of particular merit of a special form of tube.

At the completion of the operation it will be necessary to insert two tubes of the above calibre not less than four inches long in the case of a child, nor less than six inches in an adult. The discharge for the first two days will be profuse, but as a rule then rapidly subsides to a small serous liquid, which one tube is sufficient to carry off. After the 6th or 7th day the tube left in the chest may usually be shortened at each change of the dressings; but it is not easy to lay down definite rules on this head. The surgeon must be guided by the amount and quality of discharge as regards the frequency of the renewal of the dressings as well as the shortening of the tube. In some cases, especially those of children, the tube may be very quickly reduced to such a size that its internal extremity only just projects into the pleural sac. Our aim should be not to allow a piece of tubing to act as a seton within the pleura, nor too hastily diminish its power as a drainer. Larger pieces may be cut from it soon after the operation, than near the termination of the case; and the expansion of the lung, if satisfactory, will also encourage more free shortening of the tube. When a great cessation of the discharge, with perhaps expulsion of the tube from the wound, with coincident expansion of the lung, and

amendment of general health occur, the tube may be finally removed, although it will be desirable to continue the antiseptic dressings until the sinus has healed.

Drainage tubes, especially when short, easily slip into the pleural cavity, and are then difficult to recover. The dressing should be arranged about the orifice of the wound, so that there may be the least possible pressure upon it, for if the dressings press the tube past the ribs the contraction of the muscular structures of the interspace carry it into the pleural cavity without difficulty. Previous to the operation, the nurse should be instructed to carry a needle armed with strong surgeon's silk through the sides of one end of the tube, and the middle portion being taken up is divided, and the four ends tied together, having previously been united.

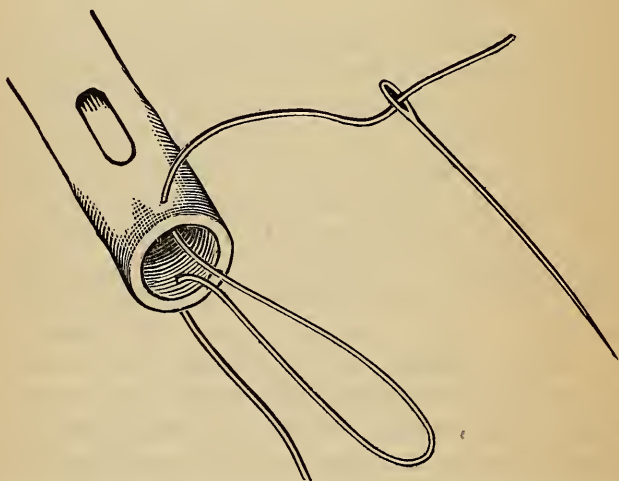


Fig. 7. Mode of securing Strings to Drainage-Tube.

The drainage tube cannot be now lost, and if it disappear within the pleural cavity it can be at once drawn out. The ends of the silk should reach at least 7 inches from the tube, and immediately before the dressings are applied should be extended upon the chest-wall. This plan answers every purpose, and is that which can be most conveniently adopted in conjunction with the use of antiseptic dressings.

CHAPTER VI.

THE ADMINISTRATION OF ANÆSTHETICS DURING THE
OPERATION OF THORACENTESIS.

Before proceeding to operate, the vexed question of the use of an anæsthetic, and what that anæsthetic shall be must be decided. Undoubtedly, cases of empyema, for which the major operation, viz., incision of the chest, can alone be needed, are not those best fitted for the exhibition of any anæsthetic; while the animated discussion which from time to time breaks out in the columns of the medical papers, between the partisans of chloroform and ether, shows us that, notwithstanding the researches of the Committee of the Royal Medical and Chirurgical Society or the individual investigations of Harley, Anstie, and others, the questions of the practical advantages and comparative safety of these substances are not settled.

The writer was attached to a hospital where ether is now administered, with certain exceptions, in all cases, where anæsthesia is required. When he was a student chloroform was employed, but owing to the melancholy occurrence of two deaths, due to its action, it was discarded. The writer, therefore, with the case recorded below has witnessed three cases where the patient (to use a literally expressive phrase of the mode of death from chloroform) has "snuffed out," besides being present several times where the fatal event seemed close at hand, and was with difficulty averted. As may be surmised, his bias is strongly in favour of ether, and his opinion is strengthened by a personal management of about 500 cases of ether administration, as well as the observation of a greater additional number, without an untoward result.

The *British Medical Journal* of 22nd April, 1882, p. 589, relates the following case:—"The patient was a young man, who was about to be operated on for empyema. When he had been brought under the influence of the anæsthetic, he was rolled over on to the sound side. Almost immediately great difficulty of breathing set in, pus began to well out of the mouth,

and he rapidly died, suffocated apparently by the accumulation of pus in the air passages. At the *post-mortem* examination, in addition to the pus in the pleura, numerous fistulous communications were found between the bronchi and the pleural cavity. This case," continues the *Journal*, "seems to us to furnish a needed warning in relation to the use of ether during operations for empyema. Ether, as was shown by the Committee of the Royal Medical and Chirurgical Society, exerts its lethal action first on the respiration; and it also, as is well known, causes a greatly increased accumulation of mucus in the throat. Both of these conditions must operate most unfavourably on a patient already deprived of all use of one lung; and when such a patient is turned on to the healthy side, not only is the action of the lung on that side still further embarrassed, but there is a great probability that pus will find its way by fistulous openings, as happened in this case, from the pleural cavity into the trachea; and there, partly by its mechanical action, and partly by exciting spasm of the glottis, determine a fatal asphyxia."

The following case which came within the writer's observation during his house surgery at the Huddersfield Infirmary may be appropriately compared with that just related.

Wilfrid Wilson, aged 7 years, was admitted on February 13th, 1881, under the care of Dr. T. K. Clarke, F.R.C.S., surgeon to the Infirmary. The history of the case extended over a long period, and he had been treated by a practitioner for "consumption," to which there was apparently no family predisposition. He was in a profound state of emaciation, and there were signs of a considerable amount of fluid in the left chest, which exploration with a small syringe proved to be purulent. It was decided to incise the left chest, and on the following day, that after the child's admission, the child's cot was drawn into the middle of the ward, Dr. Clarke being present, and the writer commenced to administer chloroform on a piece of lint. The writer's colleague coming in before the child had taken more than three or four inspirations of the chloroform, took

charge of the administration, and soon pronounced the child ready for operation, nothing unusual having been noticed. The child was turned over sufficiently to allow Dr. Clarke to make his incision in the axillary line in about the 7th interspace, and during the dissection attention was drawn to the unusual pallor of the child, and on more careful examination its breathing was found very irregular and feeble, while the pulse was barely perceptible. Artificial respiration was at once begun, the child was inverted, and a scalpel plunged into the left chest allowed a large quantity of pus to escape, cold effusion, and galvanism to the pneumo-gastric nerves were also used, but without avail. Thirty-three hours after death, on opening the chest, the pericardium was prominent and occupied a large area, its uncut surface being quite $\frac{3}{4}$ of an inch to the right of the middle line of the sternum. The right lung was prevented from coming forward as much as usual by the displaced cardiac organs, but was smooth and shining on the surface, non-adherent to the walls of the chest, and crepitant throughout but not so much as usual. No tubercle, and lung was everywhere healthy. No pleuritic effusion. The left pleura contained about $1\frac{1}{2}$ pints of thick pus, which being removed the lung was found compressed and cirrlosed, lying against the spine, and firmly adherent to it, the diaphragm and the pericardium. No adventitious products and it was non-crepitant throughout, and of an average thickness of $\frac{3}{4}$ of an inch, being one inch thick at its widest part. The pericardium contained about $\frac{1}{2}$ an ounce of clear serum. Both visceral and parietal surfaces smooth and shining. At left side adherent to compressed lung. The heart was pointing in the normal direction, and weighed $4\frac{1}{2}$ ounces. The left ventricle was in a state of systole. There was no valvular defect. The tissue to the naked eye appeared of good colour and free from fat. External fat of heart absent. A clot of firm fibrin covered with black clotted blood, the size of a small walnut, filled the right auriculo-ventricular opening, its continuations extending beneath and between the chordæ tendineæ of the tricuspid valves. A similar

smaller one was placed at the commencement of the pulmonary artery. Right side of heart in a state of diastole, and a very small quantity of liquid blood in it. No distension by black blood. Small quantity of blood only in the left ventricle.

In each of these cases—that related in the British Medical Journal, and that which I for the first time here place on record—there is no reason to suppose that the operation would have resulted fatally if no anæsthetic had been employed, but whereas in the one death was due, independently of the action of the anæsthetic, to the pus which penetrated the lungs through the pulmonary fistulæ, in the other it was directly traceable to the chloroform. In the first case we may confidently affirm that whatever anæsthetic had been chosen, the act of turning the patient on the sound side, by bringing gravitation into play, would inevitably have released some of the pus from the pleura to the lung; but, it cannot be said with equal certainty in the case of the second that death would have resulted if some other anæsthetic had been employed.

The pain of an inspiration or tapping of the chest is not severe enough to call for an anæsthetic, and I have never met with nor heard of a case where its administration was necessary or desirable. Concerning the major operation or incision of the chest for empyema I believe the employment of an anæsthetic to be advantageous; for, although, some are found able to bear unflinchingly the pain of the operation, the sensitiveness of the majority, by causing needless movements and uncontrollable writhings, interferes—perhaps in a dangerous manner—with the surgeon's duties, and if the incision be made under the spray, the need for stillness, so that it be not removed from the region of the antiseptic cloud, is apparent. Nor is it with any misgivings that I advise the employment of ether to the "surgical degree." I have administered it in these cases frequently, and it is to be regretted the reports of cases appended herewith contain no allusion to the anæsthetic employed, as the information would have

made the notes more precise and valuable; but that the point did not seem necessary to the reporter is because ether was invariably used (except in cases of children, where chloroform was substituted) and its employment is understood. The cases, 13 in number, are not sufficiently numerous to draw final conclusions from, but it is a matter for congratulation that no alarming symptoms resulted during administration, as cases where one lung is rendered more or less useless and inefficient, are among those least suited for the exhibition of any anæsthetic. In operating upon a patient under the influence of an anæsthetic we must scrupulously bear this fact in mind, and by two precautions minimise the chief danger of the operation, viz :— That of so embarrassing the action of the sound lung as to render it inactive. In the first place there is no necessity to turn the patient altogether upon the sound side, as is often done. Until fully under the influence of the anæsthetic, he should remain on his back, and when the operation is begun his position should be one midway between the supine and the lateral. It has appeared to me that a position somewhat similar to that adopted in colotomy would be of service, and an additional safeguard in the cases we are considering. It would offer no obstacle to the performance of the operation, and if the incision be made at the point I recommend, the patient would lie almost prone, and as the risks of an æsthesia do not seem greater in cases of colotomy than in those of other major operations, the shorter operation for empyema ought to be nearly as free from danger. I have not had the opportunity of putting this suggestion into practice, but I conceive that it would not be difficult to place the patient so that the sound lung should have full play.

The next precaution is celerity in the performance of the operation. "Ether," says the *British Medical Journal*, "exerts its lethal action first on the respiration;" but it is proved by experiments that the first effect of ether is to increase the number of respirations, and the inhibition of this function occurs after the inhalation has continued for some time. It appears to me that by

taking the precautions already alluded to, an empyema can be operated upon without calling this action into dangerous play. If ether paralysed the heart, as well as the respiration, as chloroform does, complaint would be more appropriate. In the case of the child, related above, there was no indication that death had resulted from failure of respiration, but rather that the heart—the mainspring of life—had ceased to act, as there was no distension of the right cavities of the heart; in fact, no sign indicative of asphyxia. The method of opening the chest which I advocate I conceive to be, when carefully and deliberately carried out, more rapid than any of those usually adopted. I have seen surgeons of repute carefully dissect the skin and muscles down to the pleural membrane, a procedure occupying time, and which I mention in order to point out the increased danger of fatal anæsthesia that it involves.

With regard to the spray, the jet must be directed upon the incision, in such a manner that the steam does not fall upon the face, and compel the patient to breathe a damp and poisoned vapour.

As soon as the incision is completed, the administration of the anæsthetic must be discontinued.

By means of Clover's small ether apparatus it is possible to have a patient ready to bear the pain of any operation in two minutes (except in certain cases of operations about the perineum and genitals) but I deprecate most strongly in cases of empyema the rapid administration of a concentrated dose. Struggling will be the consequence, time will be wasted, and that condition, cyanosis, especially to be avoided, will be promoted. And if no struggling should ensue the rapid introduction of ether, or indeed of any anæsthetic, makes the system less able to withstand the lethal effects. By slowly turning the upper part of the apparatus whilst the mouthpiece is in position, the quantity taken by the patient is accurately regulated, and it will seldom be found necessary to advance the index beyond the number "2." At every fourth or fifth respiration the mouthpiece must be temporarily

removed that the patient may breathe undiluted air, and when once under the influence of the ether the administration must be discontinued until returning consciousness, as shown by the sensitive conjunctiva, steals on. When once under the influence of ether, patients do not so suddenly and quickly return to consciousness of pain as when chloroform has been used, and it often happens in the operation for empyema, that the ether can be discontinued entirely as soon as sufficient insensibility is induced.

Respecting the accumulation of mucus in the air passages, which the *British Medical Journal* regards as a contra-indication for ether, it is a disadvantage which every careful anæsthetiser can prevent from becoming serious. The mucus rises up in the throat, and can always be safely and effectually wiped out by sticks armed with small sponges, which should be provided in all cases of ether administration. This, however, occurs chiefly in old persons, in whom empyema is uncommon, and is rarely seen unless the ether has been administered for some time, as is seldom necessary in these cases.

In the case of children not more than ten years of age, chloroform should be given; for, unless very young, it is impossible to restrain their movements. Above the age of ten years I advise ether to be administered. It will be noted in the appendix that ether was administered to a child eight years of age, see case 3 in the appendix. My experience does not corroborate the unfortunate results obtained by Bowditch and a colleague* with ether. One case died immediately after the operation, one bore it with some difficulty, and died a fortnight afterwards, with purulent fluid in the pericardium; in another, tracheotomy and artificial respiration were required to avert a fatal termination. In five cases the operation had to be stopped on account of symptoms due to the ether; and in another case, a rigor occurred immediately after the operation,

*Letter to Dr. Allbutt, *Medical Times and Gazette*, May 16, 1874, p. 527.

and was repeated three days later, when death took place. Notwithstanding this formidable "chapter of accidents," I am not induced to retract any portion of the recommendation I have given to ether as an anæsthetic in these cases, when given with needful precautions by a competent administrator.

CHAPTER VII.

PARACENTESIS IN EMPYEMA.

The accumulation of pus is as hurtful from its bulk as the pressure of a non-purulent collection, but produces, in addition, the symptoms and phenomena of which confined pus is capable. The dangers, therefore, are formidable, and include, besides bursting of the pus through the pulmonary pleura, or through the walls of the chest, the production of phthisis, induction of tuberculosis, or the setting up of necrosis of the bones of the chest, and even lardaceous disease. Unlike a sero-fibrinous effusion, a purulent, is rarely (I might almost say never) absorbed spontaneously,* and will require, therefore, operative measures. Repeated tapping or aspiration, as less formidable procedures than thoracentesis are by some recommended. The collection is drawn off, and when physical signs prove its renewal—the operation is again practised. On removal of the fluid, the lung is presumed to expand, and the subsequent secretion of pus is not so abundant as that first removed. In children I am aware that such a practice is often successful, but it is in the case of children that most success attends all the operations for empyema; and we must not accept the results of the operation in children as a criterion of the mode adopted. The pus will inevitably return, except in the youngest children,

* Hillier observes (*British Medical Journal*, vol. II., 1867, p. 80) "If the case is of very long standing, and the dyspnoea be not great and rather decreases it is better to leave the case to nature, and the purulent collection will probably excite no irritation, and its fluid portions may be absorbed." See also Wilson Fox, *British Medical Journal*, December 1st, 1877, p. 752.

the puncture is liable to give way, and allow exit of the confined pus; or, if not, the patient is exposed to the influence of a suppurative process and fluid during the treatment. The advocates of this practice aver that thoracentesis can always be performed if necessary, but surely, if the method is good, thoracentesis should not be called for, and if it should be, much valuable time will have been lost, and confinement of the lung (the most unfavourable event in cases of thoracentesis) prolonged; and hectic and the results of absorption of pent-up pus are the too frequent concomitants of the treatment; for the withdrawal of the fluid permits distension of pleural capillaries, which are then able to absorb in a more effectual manner. One preliminary aspiration, as advised by Bowditch,* Dr. Cheadle,† Wagner‡ and others, is a more reasonable procedure than attempted cure by paracentesis; but I have now given it up, and as soon as pus is found, proceed to evacuate by thoracentesis. It is impossible to select the cases in which an aspiration will cure the empyema, and with the use of antiseptics the results of thoracentesis are very good. Meigs and Pepper,|| in their work on the diseases of children, write that "In cases where the effusion is purulent, we can have no hope that the effusion will not form again, and as frequently happens, it may cause the cicatrix of the first puncture to re-open. The effusion will certainly require frequent punctures, and will certainly almost form again, and either require repeated punctures or a fistula will be established. One puncture may be made, but if a second be required, the wound should be enlarged, so as to admit of a good sized canula, which should be allowed to remain."

* Bowditch. "Practitioner," vol. I., 1873, p. 194, *et seq.*

† Cheadle. *Lancet*, November 12th, 1882, p. 822.

‡ Wagner. Quoted in *London Medical Record*, October 15th, 1881.

|| Meigs and Pepper. *Diseases of Children*. Art. Pleurisy.

THE USE OF ANTISEPTICS.

The concensus of the most recent modern experience affirms, however, the necessity of evacuation of pus by incision and subsequent drainage. Dr. Morgan* writes that "we shall be merely wasting time in attempting to get rid of fluid by the aspirator or syringe, for withdraw it as often as we please it will certainly accumulate." Marshall† says "that all sero-fibrinous pleuritic effusions may be treated hopefully by the close method, and that sero-purulent and purulent effusions cannot be so treated hopefully but require the adoption of the open method." Fraentzel,‡ although he regards two or three attempts to cure by the aspirator permissible, says "it is on account of these sad experiences, taken in connection with the fact that puncture in purulent effusions very rarely leads to recovery, that what is called the 'radical operation,' that is the withdrawal of the pus by means of an incision into the pleural sac, has come more and more into favour." And the numerous recorded results of successful cases, in the columns of the medical journals, demonstrate the increasing favour with which thoracentesis is being regarded, Surgery in all departments has achieved during the last few years results, hitherto unheard and undreamt of, many of which the antiseptic system of dressing wounds by imparting a sense of greater security, has fostered and encouraged. And none can doubt that the antiseptic mode of incising the chest, if it have not revolutionised former practice, has decreased the mortality of the operation, shortened the after treatment, and by manifesting the safety of early interference, lessened the number of cases which would terminate in thoracic fistula. To be of value the antiseptic system must be thoroughly carried out, as it is useless to continue it after putrefaction or decomposition of the secretion has occurred.

* Morgan. *Lancet*, March 5, 1881, p. 364.

† Marshall. *Lancet*, March 4, 1882, p. 337.

‡ Fraentzel. "Ziemssen's Cyclopædia of Medicine," vol. 4, p. 716.

The oil silk protective or dextrin of Mr. Lister may be safely dispensed with, and the usual gauze dressings with jaconette or mackintosh applied. The quantity of loose gauze during the first few dressings must be abundant and may be diminished as the discharge lessens, and the operation and all subsequent dressings must be conducted in the carbolised cloud of a steam spray. Instead of gauze dressings, salicylic silk, as introduced by Mr. McGill, of Leeds, may be used. It is very absorbent, a powerful antiseptic, and can be conveniently applied as a pad, a quantity of the loose silk being placed between it and the patient. A band of hospital strapping at the upper and lower borders of the pad, although by no means necessary, keeps it securely in position and tends to ensure the completeness of the antiseptic details. The dressings may, however, be effectually prevented from slipping down by carrying the last turn of the bandage diagonally over the front of the chest above the shoulder to the lower edge of the dressings behind, where it is pinned. A broad flannel bandage should be firmly applied over the antiseptic dressings and fastened in the manner just described; it keeps the dressings in their place, and from the warmth it affords is grateful to the patient.

One of the aids to the successful employment of the antiseptic system is the size of the wound, which, if large, taxes the surgeon's skill to keep aseptic, more than if less extensive. The harmlessness of aspiration and subcutaneous tenotomy, with their small wounds, which, with no other antiseptic aids than carbolic oil and cleanliness, may be fearlessly practised, is well known. Now the wound of thoracentesis is easily covered by the antiseptic spray, or, if that fail, by a piece of wetted carbolised gauze, and it requires no special skill to effectually carry out the system. In uncomplicated cases permanent high or hectic temperature, and the continuance of purulent discharge, must be regarded as indications for omitting the antiseptic dressings. The antiseptic mode of dressing is associated with two disadvantages, namely, the causation of carbolic poisoning and the lessened

facilities afforded for physical examination of the chest. With regard to carbolic poisoning, I have never seen a case where it necessitated discontinuance of the dressings; but in three cases of those in the appendix slight toxic effects were observed, namely, carboloria in cases 6, 7, and 8; and as very little carbolic atmosphere or liquid reaches the pleural cavity, this is not to be wondered at. If symptoms should demand examination of the chest, the upper region is always available for that purpose, and the front aspect can be directly examined when the dressings are changed. Should it be desirable to examine the base behind, it may be done when, after the dressings are removed, the spray is at work, and an assistant closes the wound with a wet carbolised pad. But it is at the apices that changes are most common, and the fear that antiseptic dressings will hinder the attendant from obtaining satisfactory knowledge of the contents of the chest is almost groundless. For has he not other signs to guide him?—the temperature, the respiratory movements, their rate and character, the pulse, the state of the digestive organs, and lastly, the loss or gain of weight. The latter is a valuable indication; for if with gain of weight is conjoined a normal temperature and good appetite, the physician may be sure that the condition within the chest is satisfactory. Where necessary examination of the chest must, however, not be omitted.

Thoracentesis which runs an aseptic course, places the patient in a condition more favourable than his previous state, which is usually one of hectic fever, *et id omne genus*, and the cessation of pyrexia, the return of appetite and general comfort is as welcome as it is remarkable. And by a complete system of antiseptic dressings, we protect our patients from external influences, which are liable to affect the sensitive pleura, which, on account of its susceptibility to contagion, has been compared to the generative tract of a puerperal woman.* Happily, I am not able to corroborate Dr.

*Cheadle. *Lancet*, Nov. 12, 1881, p. 823..

Cheadle's analogy; may I congratulate the antiseptic system for this result?

Lastly, antiseptics render harmless the air which enters the chest during the operation. John Hunter wrote* "The application of air to internal surfaces has generally been assigned as a cause of inflammation when it happened, in consequence of destruction of a part; but air has certainly no such effect, for a stimulus would arise from a wound were it even contained in a vacuum; nor does it get to the parts forming circumscribed abscesses, which yet suppurate in consequence of inflammation as readily as exposed surfaces. In many cases of emphysema, where the air is diffused over the whole body, we have no such effect; and how should we account for suppuration taking place in the nose during catarrh, since it is not more exposed to air then than at other times? air, therefore," he concludes "is not the cause of suppuration." A well-known surgeon informs me of the following cases—Whilst removing a very deep seated scirrhus growth from the breast, his knife passed between the intercostal spaces, and the to and fro sucking noise showed that air was passing into the pleura. The aperture was covered as quickly as possible, and the operation proceeded, and whilst dissecting the cancerous mass out of the axilla the axillary artery was divided. Strange to relate, in about a fortnight's time, when operating upon another case the pleura was again opened. Both operations were performed with strict antiseptic precautions under the carbolic spray, and both cases ran a straightforward typically aseptic course, without any inflammatory pleuritic complication, and the patient whose axillary artery was divided, was able to leave her bed on the 12th day. Now, had no spray been at work, had unaltered air passed into the pleura, would its action have been so harmless? I think not, and in support of my opinion cite the following case—A relative of my own had a scirrhus of the breast removed, and

* Palmer's Life and Works, vol. I., p. 410.

after the wound had healed and consolidated, a soft swelling of doubtful nature appeared just above the clavicle. This was explored by a small trocar, which in puncturing was forced into the pleura. It was removed as quickly as possible, but pleurisy so violent, supervened that the patient's life was for some time in great danger, although she ultimately recovered.

It is not my purpose to discuss here the theory of antiseptics, but the efficacy of the spray as a preventive of putrefaction can be very easily proved by opening 12 canisters of tinned oysters, 6 under the spray and 6 in the ordinary atmosphere, and then hermetically sealing them. After a few weeks interval those opened and exposed to the atmosphere will stink, those subjected to the cloud of spray will be sweet. The conclusion of John Hunter can be explained by the action of the lungs which render the air aseptic before it escapes into the pleura or cellular tissue; and in cases of so-called idiopathic pneumothorax, it is difficult otherwise to account for the absence of inflammatory signs.

If the antiseptic dressings fulfil their purpose it is usual for the discharge to become serous, and this change in its character is most beneficial, and I am not aware that the same event occurs in cases treated non-antiseptically. The readiness of the pleura to assume its normal state, and its tendency to return to the secretion of its natural product, when unirritated either by air or anything else, has been noticed but not commented on by other operators. In case 4 in the appendix (Ada Telford) 18 days after the operation there was slight pyrexia, and the tube was blocked and an accumulation of serous character had occurred. In case 6, the discharge observed when the case was dressed every fourth day was serous. In case 11, a blocking of the tube resulted in purulent accumulation, but the patient was one of delicate health who had been ill for a long period, and the antiseptic dressings had accidentally slipped soon after their first application. The absence of hectic, the very slight drain upon the system and consequent good health which ensue from a slight serous discharge, are practical arguments not only

for the vigorous employment of antiseptics, but for the scrupulous avoidance of injections and handling of the pleura. It is related of one of the earliest cases of empyema incised under antiseptics,* that on the 11th August the wound had healed and on the 1st of September following the man caught cold, which resulted in serous accumulation in the side which had previously held pus. Should the pus on evacuation be fœtid the antiseptic treatment should be persevered with unless the temperature proves its futility, as the tendency of the pleura is always toward recovery.

THE EFFECTS OF AIR WITHIN THE PLEURAL CAVITY.

But the effects of air admitted to the chest include not only those which (for want of a more convenient term) I denominate "septic," but also those which refer to its bulk, viz ;—The mechanical effects.

Since Boerhave wrote "*Si aeri ingressus in thoracem quantum possibile prohibetur spes est æquum convaliturum.*" the fear of admitting air into the pleura and so causing collapse of the lung, has until recent years deterred operators from adopting with feelings of comfort and security the major operation of thoracentesis. Nor was their apprehension relieved when, as Sir Thomas Watson† relates, they opened the sound side of the chest, admitted air, and literally extinguished the already impeded respiratory function. To Guthrie and Hamilton Roe belongs the credit of first recognising and pointing out that air within a pleura freely communicating with the atmosphere does not necessarily cause collapse of the lung, and I venture to think that my series of cases of thoracentesis, as well as those of other operators, amply demonstrate this

Guthrie‡ observes: "When an opening is made into the cavity of the chest in the dead body, the lung

* *Lancet*, Dec. 6, 1873, p. 809. See also Richardson Cross, *British Medical Journal*, April 29, 1882, p. 611.

† *Principles and Practice of Physic*, 5th edition, vol. 2, p. 141.

‡ *Commentaries*, p. 446.

recedes from the pleura, lining its wall for some distance; it is said to collapse, but this does not take place in anything like the same extent in the living body; and if the continued admission of air through the wound be prevented it scarcely takes place at all; or should it have done so, the air is usually absorbed, and the lung quickly recovers its natural dimensions. Neither does a wound in the chest when kept open usually cause this collapse which it is generally supposed to do in the living body. The lung can be seen in motion and performing its office, although imperfectly, as it does not fill the cavity of the pleura. To cause the complete collapse of a living lung its surface must be compressed by a fluid as in empyema, or by confined air as in emphysema, or in pneumothorax."

Hamilton Roe* quotes the following case from the practice of Mr. Phillips, at Westminster Hospital. The patient was admitted "as it seemed almost in *articulo mortis*, from the effects of extensive phlegmonous erysipelas affecting the right side of the thorax. Life was extended for many weeks, but the soft parts sloughed away, and in two intercostal spaces the cavity of the pleura was completely laid open to the extent of several inches. A very favourable opportunity was thus afforded for observing the motion of the lungs in respiration, and the influence of the external air to produce compression. The pulmonic pleura continued mottled and natural, neither inflamed nor adherent to the costal pleura. At every act of ordinary inspiration the lung came into close contact with the ribs, at every expiration the lung retracted to the extent of $\frac{1}{2}$ an inch from the ribs, showing, as it seemed, that in ordinary respiration there is a stationary condition of the lung, in which a large amount of air remains in the organ, as has been shown by experiment; and the present case is a demonstration of the correctness of that experiment. It also shows that in this quiescent condition, the air within the lung is capable of resisting any injurious pressure on the part of the circumambient air."

* *Lancet*, 1851, vol. 2, p. 435.

At the risk of being tedious I shall relate experiments made by Dr. A. H. Smith, of the United States army, and recorded in the first volume of that admirable treatise which has issued from the Army Medical Department of our American cousins.* I transcribe Dr. Smith's own words :—

“The experiments were undertaken with a view to determine why certain cases of penetrating wounds of the chest result in collapse of the lung, while in other cases, apparently similar, the lung remains distended.

“The object of the first experiment was to ascertain the manner in which the lung collapses when air is admitted into the pleural cavity. The animal was killed by a blow upon the head, the trachea exposed and secured by a ligature, and the lungs brought into view by raising the sternum. On cutting the ligature it was observed that the lungs did not recede from the thoracic wall, but withdrew themselves from the sternum toward the spinal column, keeping their external surface closely applied to the inner surface of the ribs. This was evidently due to the pressure of the atmosphere, which prevented separation of the two smooth moist pleural surfaces while it permitted one to slide upon the other, as may be observed when two moistened glasses are pressed together. This observation led to the enquiry, what would be the result if the chest were opened at a point away from the free margin of the lung? It was anticipated that, in this case, the gliding motion above described would not take place, as the air would not have access to that portion of the thoracic cavity which must be first left vacant by the retraction of the lung; namely that part occupied by its free margin. But it seemed probable that the lung tissue contracting at the point where the wound had left a vacancy in the thoracic wall, would draw with it a circle of the lung substance immediately surrounding and then form a cup-like depression, the circumference of which would go on increasing (the pleura pulmonalis peeling as it

* Medical and Surgical History of the War of the Rebellion ;
Surgical volume, pp. 631—2.

were from the pleura costalis) until the entire lung had collapsed. Experiments, however, afforded a different result, while they completely justified the anticipation with regard to the non-retraction of the lung. An opening was made in one of the intercostal spaces of a recently killed animal, care being taken to select a point as distant as possible from the margin of the lung and from the division of the lobes. The pleura costalis being carefully opened, the lung was found to remain closely applied to the wall of the chest, showing no disposition to collapse except that there was a slight depression, the margin of which corresponded exactly with the margin of the wound in the pleura costalis. That the depression did not extend further seemed to depend upon the fact that it could not exceed a certain depth without putting upon the stretch the fibres of lung tissue, radiating from its apex to the surface of the lung at a distance from the wound, and where the atmospheric adhesion to the chest was unimpaired. The wound before described, which was about midway between the sternum and the spine, remaining open, and the lung plainly visible through it, a second opening was made in the same intercostal space at the edge of the sternum. Immediately there was a sound of air rushing into the thorax, and the lungs at once began the gliding motion before mentioned, the specks of pigment in its surface passing rapidly in review before the first opening where the lung could be seen to retain its contact with the ribs, until at last its free border passed the wound and disappeared, when this opening for the first time admitted air into the pleural cavity. By inflating the lung through the trachea the experiment was repeated again and again with the same result, the lung remaining distended whenever the anterior wound was kept covered with the finger, but retracting the moment the finger was removed. These observations have since been repeated a sufficient number of times to leave no doubt that in the dead subject the lung will collapse if the chest be punctured at or very near the free margin of one of the lobes, while it will remain distended if the puncture be made

elsewhere. In the living animal the results obtained were the same, except that the lung never collapsed entirely when one side only of the chest was opened. A portion of the air in the lung on the sound side evidently passed into the other lung with each expiration and this kept it partially expanded. The degree of this expansion depended upon the character of the respiration. Thus, when the animal was fully under the influence of an anæsthetic, and the respiration not affected by the will, the collapse was more nearly complete, while the moment consciousness began to return and an attempt was made to use the voice, the inflation of the lung with each expiration became very considerable, and when a loud shrill cry was uttered, or, in other words, when the aperture of the glottis was narrowed, and at the same time a forcible expiratory effort was made, the lung completely filled out the cavity of the chest, and the edge of one of the lobes was thrust out through the wound.

“A bullock was killed by cutting the throat, ten minutes afterwards a stopcock was tied firmly in the trachea and closed, an opening was made in the 8th intercostal space in the *left* side, 9 inches from the spinal column, air immediately entered the chest and the ribs visibly expanded; as the trachea was completely closed it would seem that the retractile force of the lung tissue in the last moments of life overcame the elasticity of the ribs, resulting in a diminution in the cavity of the chest. On passing the finger into the chest it came directly upon the margin of one of the pulmonary lobes.

“An opening was made in the 7th intercostal space, on the *right* side of the same animal at the same distance from the spine. The result was precisely the same. The wound was found to be opposite to the margin of one of the lobes of the lung. On opening the stopcock both lungs immediately collapsed.

“One of the smaller lobes was detached from the remainder of the lung, and its costal surface applied to the inner surface of the chest. Seizing it in the middle between the thumb and finger, and making traction, a

considerable resistance was experienced, and the margin drew in towards the centre an inch or more before any separation between the two serous surfaces took place. At the same time a gliding motion from side to side was easily produced.

"A large dog was fully chloroformed, and a small opening made in about the middle of the ninth intercostal space on the left side. The opening came directly upon the edge of a pulmonary lobe; air entered immediately through the wound and the lung collapsed. The opening was then enlarged to the extent of about three inches, when the lung could be seen nearly collapsed, but apparently inflating a little with each respiration. The animal having regained partial consciousness, and the wound being closed by drawing the skin over it, a faint vocal sound was audible with each respiration. Uncovering the wound, this sound immediately ceased, but returned each time the opening was closed. A knife being passed through the integument, with the intention of dividing the medulla oblongata, loud cries were uttered; the lung was distended, and a portion of it was thrust through the wound.

"An animal having been killed by a blow upon the head, the trachea was opened and a tube inserted, through which the lung was fully inflated. The tube was then closed. An opening $\frac{1}{3}$ of an inch in length was made on the right side between the ninth and tenth ribs, $\frac{1}{3}$ of their length from the spine, a continuous surface of lung was exposed; on opening the tube, the chest, which was over-distended, contracted, the lung retaining its contact with the chest, but gliding upwards until the margin of a lobe came opposite to the opening when immediate collapse took place. The lung was again distended, and an opening made one space higher up, and the first wound covered; no marginal line was visible on the lung, yet collapse followed when the tube was opened. On examination it was found that the lung had not been fully distended; its complete expansion being prevented by air imprisoned in the deeper portion

of the cavity of the chest ; an elastic catheter was therefore introduced into this space through the wound, thus affording means for the air to escape. The lung was now inflated, the catheter withdrawn and the little tube in the trachea opened, the first opening in the chest being covered. No collapse took place ; the same was the result when an opening was made in the 7th intercostal space. Raised the sternum, inflated the lungs, and allowed the air to escape ; the left lung retracted keeping its outer surface in contact with the inner surface of the chest. The right lung collapsed irregularly.

“ On the right side of the body of a man who died of acute diarrhoea a small opening was made, $2\frac{1}{2}$ inches below and external to the nipple ; air immediately entered and the lung collapsed. It was found that the liver was greatly enlarged, and that the lung did not extend below the opening.

“ An opening was made on the left side of the same subject, $2\frac{1}{2}$ inches above and external to the nipple ; a continuous surface of lung was exposed to the extent of a circle half-an-inch in diameter. No collapse took place ; but there was a cup-like depression of the exposed portion of the lung ; on passing the handle of a scalpel into the wound, and lifting up its margin, air entered and the lung subsided.

“ A private of the 43rd New York Volunteers was wounded by a musket ball while on picket before York Town, about 20th April, 1862 ; the ball entered in the second intercostal space on the right side, directly above the nipple, and emerged through the centre of the scapula, appearing not to have injured the ribs, either at its entrance or exit. There was no collapse of the lung, as I remember tracing day by day the physical signs of pneumonia that followed. The recovery was remarkably rapid, and last June I met the patient walking in the streets of New York apparently perfectly well. The situation of the wound in this case was central in regard to the upper lobes of the lung, which goes to support my view ; it is possible that there may have been, however, previously existing pleuritic adhesion, but the likelihood of this is diminished by the fact that the patient was not more than 17 or 18 years of age.”

The experiments of Dr. Smith were made upon the dead subject, in which, as Guthrie points out, there is more complete retraction of the lung on the admission of air than during life; but we shall be justified, I think, in assuming that the manner in which the lung collapses in the living and the dead, from the admission of external air, are very similar if not identical. The mechanical results of an effusion within the closed chest are necessarily much more complete than those exerted by air admitted artificially through an opening maintained patent. In the former case the lung, powerless to resist, is forced aside, and its contained air driven out more or less completely; in the latter, the incision, kept open by a tube, allows egress and ingress of air, while the movements of the chest wall, the exercise of the lung in speaking and bodily exertion, promote expansion of the lung, to which there is now little hindrance from intra-pleural pressure.

There is abundance of proof—as evidenced by the clinical histories of recorded cases—that the admission of air within the chest is no bar to the ultimate complete expansion of the lung. How far the antiseptic dressings conduce to this result it is impossible to determine, but I should be inclined to allow them a share in the process. At each change of dressings, as soon as the gauze or silk is removed, the sucking of air through the tube begins, and continues until the tube is covered up by the clean dressings. The aperture is always embedded in the loose gauze, and the well-applied pad, with its jaconette or impermeable macintosh, prevents the penetration of air to the tube. I conceive that the aseptic air which the chest contains is partially absorbed by the pleura, and coincidentally expansion of the lung goes on. If the lung tend to expand more rapidly than the pleura can remove the contained air, the tension within the pleura will be again set up, to be relieved at the next change of dressings. As air is never found under the dressings none escapes from the chest in the intervals between their change. Assuming that this sequence of events does occur, and I think it best explains the *rationale* of

the curative process, the necessity for frequent change of dressings for some time after the operation is apparent. I am aware that dressings other than the antiseptic may be as effectual, in temporarily disconnecting the chest cavity from the external atmosphere, but then the isolation of the pleura is not maintained at the change of dressings.

Some operators recommend the use of mechanical valves, which opening only in one direction, permit the flow of fluid or air through them, when applied, only from the pleural cavity.

Dr. A. H. Smith, whose experiments have just been quoted at length, uses a leather disc, perforated to receive a glass tube and valve which fits the wound, and thinks that* "the motion of the chest would pump out the air in the pleura, unless the lung be wounded in such a way as to open a free communication between the bronchial tubes and the pleural cavity, it must eventually expand again to its normal dimensions."

Dr. R. J. Lee† advocates the use of an india-rubber cap for this purpose, but the most complicated contrivances cannot more efficiently prevent access of air than accurately adjusted antiseptic dressings, and they, like the latter, must be periodically removed for examination, or in case they get blocked, when air is admitted again into the chest.

COLLAPSE OF THE LUNG.

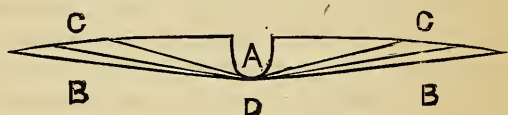
The experiments of Dr. Smith clearly show that collapse of the lung after the admission of air within the chest, is determined by the proximity of the puncture to the free edge of the lung. The lung keeps in contact with the chest wall normally, and the adhesion is caused and maintained by the pressure of the air in the lung, and there is apparently no reason to assume that in the healthy state, the cohesion of the visceral and parietal pleura is not persistent as well as complete.

* Medical & Surgical History of the War of the Rebellion, vol 1,
p. 672.

† *Lancet*. June 5, 1880, p. 899.

In abnormal states the adhesion of the two surfaces is with difficulty severed; it is the safeguard and protector of the lung from external injury, and even when complete collapse of the lung is brought about, its adhesion to the opposing pleura continues; as the lung slides upwards its bulk diminishes, but its adhesion to the chest wall remains as tenacious. If two smooth pieces of moistened glass be put close together, and we endeavour to separate them by lifting one of them perpendicularly, the attempt, unless very forcible, will fail; but if, by a change of tactics, one of the glasses be pushed along the surface of the other, very little pressure is necessary in order to completely detach them. So it is in the case of the lung. Whilst the air impinges on the pulmonary surface in a direction perpendicular to the wall of the chest, it cannot overcome the sucker-like action of the opposed pleura, further than to liberate a small area of lung as shewn in the accompanying diagram. The res-

piratory movements change the air which thus



gains admittance, and should the to

A. Depression in lung opposite wound. B. Lung taking its fixed point at C, and opposing further depression at D, (after A. H. Smith).

and fro gliding movements of the lung bring its margin or that of one of its lobes to the level of the opening, air at once passes beneath it; and then acting in the same manner as the force which so easily slides the pieces of moistened glass apart, it presses the lung upwards by sliding it along the side of the chest. To appeal once more to physics for an example to render our meaning more intelligible, we may point out the readiness with which a leather sucker may be removed from the weight it lifts, by skilfully raising its margin, whereas considerable exertion is necessary to pull it directly away.

It would seem that our forefathers were of opinion that in the chest was a vacuum which the air, as soon as admitted, would fill. A vacuum undoubtedly there is; but it is such an one as that beneath the well-fitting

sucker, and one which is obliterated by the thoracic viscera, and in the healthy individual practically absent. The experiments of Dr. Smith show that the external air, unless admitted to the chest in a particular manner, will not cause collapse of the lung in the dead subject ; while the case related by Hamilton Roe (*see p. 127*) demonstrates the groundlessness of fear in the living subject, in whom, as we know from experience, a compressed lung may expand though the wound of thoracentesis exist.

Even after the removal of fluid has left a real vacuum, which air enters through the wound to fill, the compressed lung will, in the living subject, expand, although a substratum of air is constantly below it. In the dead subject we know that collapse of the lung would occur in such circumstances. Wherein lies the difference ? And in attempting to answer this question we shall have to learn how an empyema heals. The following authentic description of the *post-mortem* appearance of the chest of a boy, aged 7 years, who recovering from an empyema of the right side, which was incised, died from cholera one year and nine months afterwards,* will assist us in the enquiry.

“ Body plump with a layer of fat about one third of an inch thick, beneath the integuments of the chest and abdomen. The right side of the chest was less prominent than the left, but not to any marked extent, the difference between the two sides being chiefly noticeable at the nipple ; the chest below this was well rounded. The cicatrix ” (in the 3rd interspace, one inch posterior to the nipple line) “ presented a healthy appearance. The sternum and costal cartilages were removed with some difficulty, owing to the close cellular connection of the pleura on the right side ; and in the space so exposed were seen portions of both lungs, and occupying the centre of the space was the large thymus gland, spread out broadly and closely adherent on its under surface. On the right side the lung approached nearer the median line than on the left ; the portion of

* On a Case of Empyema. Mr. Sedgwick. *Lancet*, May 20, 1854.

the right lung visible was about an inch and a half in breadth, and extended forwards from below the lower edge of the first rib to the lower edge of the fifth; a small portion only of the lung was seen on the left side above. The colour of the lungs was about the same, on both sides presenting a bluish marbled appearance. On the right side the adhesions over the anterior part and towards the right of the lung, although very close and firm, could be separated by careful dissection with a scalpel; and towards the apex they could be almost separated by the fingers, with very little assistance from cutting. Posteriorly and laterally the adhesions were too close and firm to render it possible to take out the lung entire, and accordingly the seven right upper ribs were sawn through, and removed with a portion of the lung for examination. The adhesions in the neighbourhood of the cicatrix were found to be very thick and gristly, and it was only by transfixing the cicatrix that it was possible to trace its exact position on the inner side. The lobes of the lung were closely adherent and could not be separated."

Briefly epitomised these notes read, complete adherence of the right lung by means of false membrane to the chest wall, and Hutchinson† mentions a case where "the lung could not, in consequence of pleuritic adhesions be removed from out the thorax; indeed, there was not one square inch of pleura which was not firmly adherent. The lungs had to be torn out by little pieces, and so strong was the adhesion to the diaphragm, that in removing them this muscle was ruptured."

Thus, the lung driven against the costal pleura by the accumulated fluid, at length becomes intimately adherent to it by its inflamed pleural surface. Every movement of the chest parietes now drags the surface of the lung with it. During the persistence of the fluid the degree of motion is small, for the ribs pressed out

† J. Hutchinson. *Cyclopædia of Anatomy and Physiology*.
Article—"Thorax."

by an excessive quantity are prevented from rising and falling; whilst the distension of the chest stretches and paralyses the intercostal muscles. When relief is afforded by evacuation of the fluid, the character of the respiratory movements is improved; they diminish in frequency as well as in shallowness. The lung being now adherent is dragged by the ribs in all their increasing movements, which may rupture the false membrane limiting the lung below, and which, if not too dense and firm, will be torn and burst by the expanding lung relieved by the substitution for the pressure of fluid of the lighter atmospheric one. As the lung expands the adhesion to the chest wall increases; and at length, as in the cases of Mr. Sedgwick and Dr. Hutchinson, the pleural cavity is entirely obliterated by universal adherence. The cavity being gradually diminished, the contained air is slowly expelled; and unless the adhesion of the pleural surfaces re-open, the air cannot return. There is no fear of persistent pneumo-thorax. Each fresh expansion of the lung results in further adhesion to the costal surface, which then acquires more power over the lung to promote its return to the normal state. If the adhesions of the compressed lung are so complete and permanent, the lessened tension and respiratory movements may be inadequate to cause much expansion; the moral to learn from this is to operate before the adhesions have had time to consolidate. After a serofibrinous effusion, the same adherence of the pleural surfaces ensues, and by early relief of the tension, so as to induce absorption, we endeavour to promote this desirable event. We thus learn, that adhesion of the lung to the chest wall is a desirable event; when it has taken place the lung must follow all the movements of the chest parietes, which removal of fluid will induce, its expansion being then promoted, and the air admitted to the pleural cavity by thoracentesis is also prevented from returning, the suppurating surface is gradually diminished, and cure, whose completeness depends chiefly upon the duration of the case before operation, and also upon the state and constitution of the patient, is the happy result. It is

encouraging to know that such adhesions make no difference to the vital capacity of the individual,* and that from want of the gliding of the pleural surfaces upon each other the respiratory function is practically as good as normal though not physiologically as perfect.

Thus the admission of air within the pleura does not necessarily cause collapse of the lung, and when admitted by thoracentesis, its pressure is less hurtful than that of the effusion which is then removed; and its supposed irritant effects upon the pleura are imaginary, as cases of simple pneumothorax and cases of empyema treated by antiseptic incision prove, as also is the fear that it will be a hindrance to the after-expansion of the lung. The case recorded by Roe, in which, although no antiseptics had been employed, "the pulmonic pleura continued mottled and natural, neither inflamed nor adherent to the costal pleura," may raise doubts as to the necessity of the antiseptic system of dressing. But in every patient the effect of admitting unaltered air would not be so harmless, and we must, therefore, protect all in the most efficient manner. This case proves, what I have already insisted upon, that the prejudicial influence of the air is not exerted upon the pleural membrane, but upon the fluids which it may have secreted.

OTHER MODES OF PERFORMING THORACENTESIS.

If the entrance of air into the chest is favoured by making an aperture opposite the free border of the lung or its lobes, we should select for the incision a point safely removed from the margin of the pulmonary tissue. Anteriorly—from the conical form of the lung—there is more danger of permanent admission of air, than upon the flat posterior surface; although after incision close to the nipple, cases have frequently recovered. But it is when the chest is opened at its lowest limit that the thorough expulsion of air by the expanding lung would apparently be most difficult. The air is then admitted directly beneath the lung, and

* Hutchinson. *Cyclopædia of Anatomy and Physiology* Art Thorax.

although the gliding motions of the pulmonary surface have been annihilated by the adhesion of the layers of pleura, each respiration will draw in an additional quantity of air, which will readily enter under the free border of the lung, and the case may be unduly prolonged. If, however, the incision be made so that on expansion of the lung air impinges perpendicularly upon its surface, in the same manner as in the healthy structure, the admission of more air will be prevented, and if any is forced by the increasing size of the lung, below the level of the incision, it will, being "aseptic" do no harm, and will soon be absorbed by the pleura.

The point at which we recommend the chest to be opened is between the margins of the lower pulmonary lobe (*see page 15*); but in all but very recent cases the lobes of the lung will have been united by the inflammatory process, and, practically, their existence may be disregarded. However, if the results of, and conclusions to be drawn from Dr. Smith's experiments, be accepted, it imparts confidence to know that the puncture will not admit air from nearness to the pulmonary lobes. In selecting the point of incision, another most important item of treatment must be considered, viz., that of good drainage. The admission of air is only innocuous when drainage is perfect. If any accumulation of secretion take place pyrexia returns, and as the vacant space is now filled by air, increased tension within the chest and pressure upon the thoracic viscera are re-produced.

The lowest point in the chest has often been selected as the most eligible and favourable situation for securing efficient drainage, in accordance with the recommendation to open a suppurating cavity at its most dependent part. But the most dependent point of the pleural cavity varies with the position of the patient; in the prone and supine position the middle of the anterior and posterior thoracic walls are doubtless the most dependent parts, to be altered in the lateral and erect postures to the most bulged portion of the side, and the lowest limit of the upper diaphragmatic surface. Now, the patient, after thoracentesis for

some time subsequent to the operation, whilst the discharge is most abundant, lies most often upon the back, turning, perhaps, for a change upon the injured side; or, as strength returns and the discharge diminishes, sitting up in bed. An opening, therefore, in the dorso-lateral aspect of the chest is that best calculated to promote thorough drainage. When the patient is fit to get up, the amount of discharge will have reduced to a slight secretion of a serous character, which occasional diurnal assumption of the supine position, and the drainage during the night will be adequate to remove. At each dressing the drainage tube should be removed, cleaned, and re-inserted. If the patient cough, the cavity of the pleura can be emptied of any discharge it contains, the character of which is at the same time observed.

We recommend the 8th space, at a point behind the axilla found according to the directions given at page 13, as the site at which the most efficient drainage can be secured, as well as the point at which the admission of air is least likely to be a hindrance to expansion of the lung.

If the chest be opened near its inferior limit, as Marshall* points out "when the distended pleura is being emptied, the chest walls fall in, and the depressed diaphragm ascends whilst the costal and diaphragmatic surfaces of the pleura, inflamed and covered with organized lymph or granulations, approximate, and if not prevented, will cohere. If, in any case, a puncture or incision has been made in the 8th or 9th interspace, or even in the 7th, the aperture has a marked and troublesome disposition to be closed by the diaphragm; and if the drainage tube has been inserted and a long one then becomes necessary, the lower part of the tube, placed between the chest wall and the movable diaphragm, keeps up local irritation, maintains suppuration, and prevents the curative process of adhesion. In four cases of chronic empyema, recently

* Marshall. *Lancet*, March 4th, 1882, p. 337.

or now in this hospital, in which the chest was opened in the 7th, 8th or 9th space, and in every other case of low operation which has come under my observation, the aperture has tended prematurely and obstinately to close, whilst the drainage tube has been nipped between the diaphragm and the ribs, and has interfered with the wished-for cohesion between the costal and diaphragmatic pleura. In all such cases, I find that a long probe passed into the aperture is immediately deflected upwards by the diaphragm along a narrow space and then enters a wider cavity higher up."

Adhesion of the pleural layers is not limited to the pulmonary and parietal surface, but takes place also between the diaphragmatic and lower portion of the costal pleura. Any incision, therefore, below the level of the diaphragm with insertion of a tube, interferes with this adhesion, and further irritates the already inflamed surface, and impedes, if it do not prevent cure. Now, the 8th interspace at the point we recommend for incision, is higher than that advised by Mr. Marshall, being on a level with the lower border of the 4th interspace, which corresponds with the height of the diaphragm in forced expiration, and a tube pushed into the pleura here passes above the diaphragm; and, except in case of very unusual ascent and adhesion, never passes between it and the chest wall. The danger which Mr. Marshall points out, therefore, does not exist when my directions for the operation are followed, and Mr. Marshall's denunciation of the 7th, 8th and 9th interspaces would have been more definite and convincing if it had stated what part of these interspaces was meant. For, in the axilla the 8th space lies much lower than near the spine, or close to the sternum, and, in the axillary line the 6th interspace is that at which thoracentesis is usually practised. Again, Mr. Marshall's arguments would have been strengthened had he stated the duration of the "four cases of chronic empyema" before the operation was performed, as the most favourably situated incision will fail to cure a case where, from too long delay in operating, the lung has been permanently bound down.

Indeed, the converse proposition is true, that incision at the lowest point of the pleural cavity, close to the diaphragm, will often cure if it be undertaken sufficiently early.

In a later lecture (*Lancet*, Mar. 11th, 1882, p. 382), Prof. Marshall speaks of four cases in which "very large quantities of fluid had accumulated in the chest before the open treatment was adopted, so that the lung had been much compressed." Again "the fluid had been long retained, so that the lung had undergone a prolonged compression." If these are the same four cases we are now considering, our side of the question is strengthened.

Mr. Marshall advises that the incision be made in the fifth interspace anteriorly near to the nipple, regard being had for the pericardium on the left side; and quotes the practice of Roser, Billroth, Wagner, and Morgan in support of his views.

We have previously commented upon the danger of wounding the diaphragm by the anterior incision, on account of its nearness to this aspect of the chest (*see p. 7*), and its perforation by so skilled a thoracic anatomist and cautious investigator as Laennec, proves that this danger is as great, if not greater, on the anterior as on the posterior part of the chest-wall. Watson* relates the same accident at a corresponding point on the opposite side of the chest. In the Medical and Surgical History of the War of the Rebellion (vol. i. p. 504) is recorded a case in which two small wounds were made by tapping, one between the 6th and 7th ribs, two inches behind the nipple; the other, made between the 5th and 6th ribs. On examination, 14 hours after death, both were traced through the walls of the chest, into and through the diaphragm, into the liver.

There is no doubt that false membrane gravitates to the posterior portions of the chest, partly because the highest point of the diaphragm being in the anterior part of the chest leaves a longer decline towards the

* Principles and Practice of Medicine vol. II., p. 149,

posterior part; but chiefly because the recumbent posture is the most usual, I have not, however, seen nor heard of a case where, from the presence of false membranes, or unusual adhesion of the diaphragm to the chest wall, the operation had to be performed at another spot than that I have indicated.

Prof. Marshall draws attention to a certain spot in the thoracic wall (*see page 9*), at which, he says, the *empyema necessitatis* most usually appears. At the present day a perforating empyema is rare, and the only case I have seen is that of France Preston (*case 36 in appendix*), in which the empyema pointed at the site of a previous paracentesis puncture. An empyema penetrates the weakest part of the chest wall. If no puncture cicatrix exist, then the pus most easily burrows through at the fifth space, although it very often happens that a swelling at or near Mr. Marshall's "spot of spontaneous perforation," does not originate there, but has run along the intercostal space from the axilla at the point where it left the pleura. The muscular covering at the posterior line of the axilla prevents its passage backwards, or it might possibly appear close to the scapula. To indulge in the platitude that perforation of an empyema at the fifth space is "an effort of nature," may be permissible; but to ask that we should accept it as an argument in practice weakens the cause which it is intended to advance. Prof. Marshall says that, "an empyema may be regarded as a great pleural abscess, and, as we know, abscesses often point opposite their centre."* Now, the only point of resemblance between an empyema and an abscess is the pus which each contains. Their origin is different; for an empyema may appear as a sero-fibrinous effusion, and the inflammation which in the case of the pleura exudes organizable serum, would in the cellular tissue of the body produce pus. That something more than intra-pleural pressure and tension are requisite to cause spontaneous perforation is clear,

* *Lancet*, March 4, 1882, p. 337.

as the perforation of empyema, and non-perforation of the most abundant non-purulent collections, which have produced much displacement of organs, show. But, notwithstanding, it is in accordance with the laws of physics, that the empyema points at the spot of least resistance. If the structures of the eleventh interspace were weaker than those of the fifth, the spot of spontaneous perforation would be located there; and would Mr. Marshall, then, pursuing his argument and following what he calls the lead of nature, incise the chest at that point? We think not. But the perforation of an empyema certainly does not occur in fifty per cent. of the cases, and when it does take place it is not always at the fifth interspace. So that the perforations in the fifth space are small, and if it were an effort of nature, would not nature more frequently adopt this means of cure? In printed records I have found the following cases of spontaneous perforation, among which are not included those that came through at the point of a previous puncture:—

PERFORATION OF AN EMPYEMA.

Point of Perforation.	Reference.
2nd & 3rd intercostal space—	Wood, Lancet, March 7th, 1874, p. 645.
Junction of 3rd rib with sternum—	Charles, Lancet, July 31st, 1880, p. 162.
4th space in axilla—	Todd, Lancet, October 6th, 1860.
5th space, just below nipple—	Chambers, Lancet, May 31st, 1862, p. 573.
5th space in axilla—	Rogers, Lancet, January 30th, 1864, p. 118.
Under right nipple—	Wilks, Lancet, October 30th, 1875, p. 624.
Under true ribs in anterior axillary fold—	Dublin Journal of Medical Science, November 1876, p. 361.
Between 6th & 7th ribs, below right nipple—	Hughes Bennett, Principles and Practice of Medicine, p. 618.
6th interspace in lateral region—	Elliott, Lancet, Oct. 18th, 1879, p. 569.

6th interspace in lateral region—Wardell, *British Med. Journal*, November 7th, 1874, p. 580.

Cartilages of 7th & 8th ribs on right side—Laennec, *Diseases of Chest* (Forbes) p. 534.

Between 7th and 8th ribs, 3 inches from median line—Habershon, *Lancet*, Nov. 12th, 1859.

Between 7th and 8th ribs, 3 inches from median line—Wilks, *Ibid.*

8th interspace—Pollock and Symes Thomson, *Lancet*, August 15th, 1863.

8th interspace, at junction of diaphragm with ribs—Willshire, *Lancet*, May 31st, 1862, p. 573.

9th interspace—*Lancet*, January 27th, 1872, p. 114.

Lower part of back—Hughes Bennett, *Principles and Practice of Medicine*, p. 622.

Beneath Scapula—Hunter, *Dissertio de empyemata*.

The above list is neither complete nor representative, and I regret that difficulty in procuring books, as well as want of time, have not allowed me to make it more valuable, but it sufficiently proves that perforation of an empyema may occur at a lower point than the 5th interspace; although there is no doubt that it is more frequent at or above that spot. If perforation of an empyema be an effort of nature, it is astonishing how seldom she adopts that method of cure.

If the perforation of an empyema is an effort of nature so also are the protrusion of a hernia and the formation of a meningocele, both of which result from the yielding at the weakest point of the respective cavities; and, it is possible that the pointing of an empyema is most frequent in front because the abundant deposition of false membrane upon the posterior thoracic wall, strengthens and renders that region less pervious.

Nor does it follow that because pointing occurs oftenest at the point indicated by Mr. Marshall, that it is on this account the best situation for the incision. Suppuration in other parts of the body is not always most satisfactorily treated by opening the most bulging portion, and if practised as a matter of routine, the after-formation of a counter opening will in many cases

be imperative. Mr. Marshall makes this quaint observation, "by making the opening as high as practicable, either at or near the level with the common spot of spontaneous perforation, a very short tube will be sufficient *to drain the upper part of the cavity*, whilst the lower part will close up by contact and gradual adhesion of the diaphragm with the chest wall, and requires no drainage." Mr. Marshall is, as far as I am aware, the first surgeon who has advocated the drainage of the upper part of a cavity, to the neglect of the more dependent portion. Pus will gravitate to the lowest limit of any cavity, and, although adhesions of the diaphragm may occlude the lowest recesses of the pleural cavity, they will not prevent contained secretions from reaching its posterior aspect, unless a prone position be observed. Indeed, one of the authorities whom Mr. Marshall cites in support of his views, speaks thus* in describing the operation, "The patient should be directed to lie on his side for about 48 hours, in such a position as shall favour the escape of pus from the thorax. A four ounce exhausting syringe should be attached to the catheter, and with it the remaining portion of the purulent exudation should be thoroughly removed. *Unless a syringe or aspirator be used, comparatively little fluid will escape.*" And if there is difficulty in removing the fluid at the operation, will it not also be felt during the after treatment.

The gravitation of pus to the posterior chest wall is also shewn by the fact that if two openings be made, anterior and posterior, the anterior closes first, of which an example is afforded in the case of Wm. P.,† who was admitted to the Brompton Consumption Hospital, under the care of Dr. Theodore Williams, on July 4, 1871, with a history extending over four months, and commencing with "severe cold and rigors."

On July 10th, Sir William Fergusson passed a trocar and canula between the 5th and 6th ribs, about

* Professor Morgan. *Lancet*, March 5th, 1881, p. 364.

† *Lancet*. February 24, 1882, p. 251.

4 inches from the nipple, on the right side, and drew off 4 pints of purulent fluid.

July 17th. Swelling in right mammary region, and pus oozes from the wound. Temperature has fallen from 103° to 100° .

July 22nd. Swelling opened with a bistoury and pus streamed out.

August 5th. On passing probe into wound, it passed between intercostal muscles to site of paracentesis puncture, and thus into the pleura.

August 22nd. Discharge has become offensive, appetite has been lost, he has been taking champagne and brandy, and there is much scalding pain in the wound. A counter opening was made by Mr. Henry Smith, in the 7th interspace, 2 inches from the spine.

August 24th. Discharge is so copious that it soaks through everything, and amounts to some pints in 24 hours, still offensive. Temperature 99.1° , the first time it has been below 100° for 6 weeks. Drainage tube passed from the front opening to that behind, and injection of carbolized solution used.

August 25th. The change in the patient from yesterday is quite wonderful. He has slept well and is free from pain and discomfort.

September 7th. Champagne stopped and brandy discontinued.

September 29th. Getting fat. Examined by Mr. Smith who said "he had never witnessed so complete a resurrection."

November 10th. Cavity remains in chest and holds 2 ounces. Thorax so fat that the ribs cannot be felt. Anterior opening closed.

That the above is not an isolated instance of a sequence of events as there described the experience of my readers will decide, and in connection with it the following epitome of a case under Dr. Russell, of Birmingham, may be appropriately inserted.*

* *Lancet*, May 3rd, 1873, p. 629.

The man came into Hospital with an opening between the 5th and 6th ribs, an inch outside the nipple. After 3 month's stay in Hospital a counter opening was made behind in the 8th interspace. "During the 106 days which preceded the making of the counter opening, the temperature, pulse and respiration had been regularly noted by the Clinical Assistant, Mr. G. W. Blake. The temperature was persistently above the normal standard. For the first 45 days the evening temperature was 12 times above 102° and 102.5° , and, although subsequently the temperature in the evening ranged between 100° and 101° , it only three times fell within the normal range, and was above 101° within 4 days of making the opening. The morning remissions in the majority of days (63) were within the standard of health. The pulse retained relation to the temperature, but the breathing, though occasionally quickened, ordinarily ranged from 18 to 22. Four days after the opening was made, the temperature fell permanently and completely to the normal standard, and the appetite, not previously bad, underwent such an increase as to surprise the patient. The chest contracted, the ribs became somewhat flattened at their angles, and a slight double curve appeared in the vertebral column. The counter opening was made on September 26th, and the drainage tube was removed on October 30th. Some deformity of the chest was left, but there was otherwise a good recovery."

In a case related by Hughes Bennett,* an incision was made into an empyema where it pointed, viz., the 6th interspace, but subsequently two additional tumours formed spontaneously a little lower down.

The chief advantage of an anterior opening in the 5th interspace is that this space there is wide, and allows easy passage of the finger into the chest, for purposes of exploration. It is, however, a bad practice to insert the finger, and one which in ordinary cases is not called for. Not only is the 5th interspace wider during

* Principles and Practice of Medicine, p. 618.

health, but its comparatively greater breadth is increased, by deformity of the chest, one result of which is to narrow the posterior spaces. Thus, a posterior opening may be narrowed, its sides approximated, the lining granulations tend to unite, and from nipping of the tube, drainage may be interfered with. But it is when the operation has been too long delayed, when the lung cannot expand that such deformity endeavours to obliterate the cavity in the chest. The attendant nipping of the tube is not the direct result of the position it occupies, but the necessary and avoidable consequence of a procrastinating operator. The cases in the appendix, in none of which was difficulty in keeping open the wound tract observed, should answer this objection to the posterior opening, while the unavoidable free drainage—with concomitant good effects upon the patient—should be steadily kept in mind. That the walls of the chest will collapse towards the centre of the distended cavity, as Prof. Marshall assumes, is scarcely possible, for it is not to drawing in of the thoracic parietes, but to bulging out of the contained lung, that we look for healing of the empyema, and although in protracted cases deformity occurs, it never resembles the collapse of the walls of an abscess after its evacuation.

Prof. Marshall says the success of his operations has been greater since adopting the anterior opening, and we do not doubt that he has good practical reasons for adopting his present mode of operation; our remarks have been made to defend the posterior operation from the aspersions cast upon it by Mr. Marshall, and to prove, as we hope our cases may, that it is a most successful procedure, and one whose results will amply satisfy the surgeon; and that it is not open to the formidable array of objections invoked by Mr. Marshall. Whilst remaining otherwise strictly defensive we wish to enter an emphatic protest against designating as an effort of nature the spontaneous perforation of an empyema, as we believe that it is the result of unavoidable, and often accidental, local conditions. We have shown also that by movement of the arm a disposition of muscles

facilitating entrance of the chest can be secured at the latero-posterior aspect of the thorax (*see p. 11*).

DRAINAGE TUBE.

Many forms of drainage tube are recommended after thoracentesis, and we have already expressed a preference for a broad guage tube of perforated india rubber, with a length of silk attached, in case it should fall into the pleura. To prevent the tube from receding into the pleura, a harelip pin may be passed transversely through it, and the points then guarded by flat pieces of cork, in order that they may not injure the integument. But this method is more serviceable in dealing with limited empyemata or protracted cases than with large recent effusions.

Meigs and Pepper,* Marshall,† Morgan,‡ Trousseau|| and Fraentzel¶ used a silver canula, the inner extremity of which just projects into the pleural cavity. Meigs and Pepper direct that the canula "should be curved, so that its extremity may not come in contact with the gradually expanding lung, and its shield should be furnished with a ring of caoutchouc placed between the instrument and the skin to prevent excoriation," whilst Marshall insists that the curve of the tube should be "slightly upwards."

Morrant Baker's tracheotomy tube, the ordinary tracheotomy tube, and Holt's winged catheter, Callender's self-retentive drainage tube and the ordinary gum elastic catheter have all been used.

* Meigs and Pepper. *Diseases of Children*,

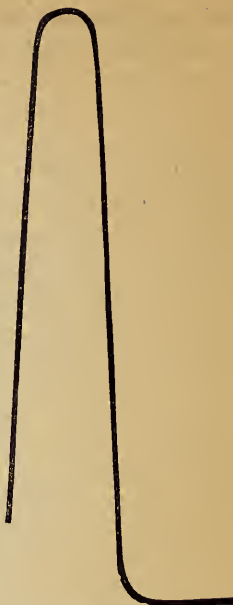
† Marshall. *Lancet*, March 4th, 1882, p. 338.

‡ Morgan. *Lancet*, March 5th, 1881, p. 364.

|| Trousseau. "Clinical Medicine," vol. III., p. 284.

¶ Fraentzel. "Ziemssen's Cyclopædia," vol. IV., p. 629.

During the American Civil War, a simple but apparently efficient substitute for the drainage tube was employed at the Armory Square Hospital.* "It consisted simply of a bent watch spring, of the form indicated, with sufficient elasticity to support the walls of long fistulous tracts in the soft parts. In suppuration in the thick muscles of the thigh or calf, in compound fractures, this simple expedient was found far preferable to any form of tent or drainage tube, and it could be used advantageously in sinuses on the anterior aspect of the chest and abdomen. The utility in cases of thoracic fistula of keeping the pleural cavity as far as possible free from decomposing fluids was universally acknowledged." We have ourselves never used it, but conceive that it would answer the requirements of thoracentesis.



Watch Spring Dilator
for Sinuses.

Morrant Baker's empyema stem, is a contrivance, very useful in cases where intra pleural injection is desirable, but otherwise does not call for comment.

In the *British Medical Journal*, for July 15th, 1882, Dr. Hensley describes a form of drainage tube, the employment of which, in conjunction with antiseptic dressings would not be practicable, although we are aware, that, after antiseptic excision of the breast, drainage, by means of a long tube passing through the dressings into a bottle containing carbolic solution has been successfully carried out. In chronic cases, the tube might be of service. Dr. Ward Cousins, a prolific inventor of surgical contrivances,† has introduced what appears to be a useful tube, with

* Medical and Surgical History of the War of the Rebellion,
vol. 1, p. 580.

† *British Medical Journal*, June 2nd, 1883, p. 1073.

arrangement to prevent it slipping into the chest.

Although, in exceptional cases, these various devices and inventions may be useful, they may be regarded as being unnecessary in the majority of cases, in which they possess no advantage over the ordinary form of drainage tube. The particular form of tube employed is, however, immaterial, if it acts well in carrying off the effused material. The form of tube I employ is sufficiently strong to keep open the wound, unless deformity of the chest set in with consequent approximation of the ribs posteriorly. It acts as efficiently as a metallic canula, and without irritating the skin and cellular tissue, as the latter sometimes does, and when any deformity of the chest takes place it is compressed instead of presenting a hard unyielding structure, against which the approaching ribs may press and become eroded.

The length of the tube as recommended may seem excessive, but I have never seen harm result from it; and it can be rapidly reduced, according as the secretion of pus diminishes.

Morgan removes the canula in three days and plugs the wound with a piece of lint, and if any closure of the wound occur, a sponge pessary is put in to enlarge it. In addition to the fact that the lint may be drawn into the chest, as occurred to a patient of Mr. Durham's* the lint defeats the object for which the incision was made, viz. :—removal of pus; as also do the plugs and spiggots fitted to canulas and drainage tubes to be removed once or twice in the 24 hours; and the drainage then instead of being continuous, is converted into a system, analagous to the repeated performance of paracentesis. Except in chronic cases of some standing, the drainage tube should never be thus artificially blocked, for accumulation within the pleura, absorption of the secretion, and a state bordering upon, if not one of absolute, hectic, are the result.

* *Lancet*, November 22nd, 1873, p. 739,

OTHER MODES OF TREATING EMPYEMA.

The following is a collection of the various operations practised by the older writers.*

By boring through a rib—Hippocrates, Paré, Severinus.

By boring through the breast bone—Galen, Roger of Parma, Purmann, Van de Wyl.

By dividing soft parts by the actual cautery—Euniphon of Cnidos, Paul of Ægina, Avicenna, Lanfranchi, Ravaton.

By dividing soft parts by caustic and thrusting a knife through the slough—Thevenin, Ruysch, Bromfield, Von Winter.

By puncturing with a knife after making a cut through the skin to lay bare the pleura—Hippocrates, Celsus, Solingen, Delpech.

By puncturing with a trochar after making cut through skin—Heister, Morand, Boyer.

By puncturing with blunt instrument after do.—Dionis, Verduc, Belloste.

By puncturing with finger after do.—Freck.

Without previously cutting through skin by thrusting in a knife.—Rhazes, Diemerbroeck, Purmann.

By thrusting in a trocar simply—Drouin, Nuck, Palfyn, Heister, Sharp, Leblanc, Rullier, Charles Bell, Laennec, Wattmann, Schuh, Krause.

By dividing the skin and muscles with a funnel-shaped cut and dividing the pleura to a great extent—Benj. Bell, Larrey, Zaug, Kern.

When discussing the relative merits of the anterior and latero-posterior incision we avoided reference to the after treatment followed by some operators, who select the anterior aspect of the chest by preference, and in inserting the description in this section of our essay, we cannot refrain from observing that the necessity for such manœuvres is an additional forcible argument in favour of our own mode of operation.

* South's Chelius, vol. ii. pp. 473—4.

Thus Wagner,* “in order to promote free discharge during the after treatment, keeps his patient lying on the side, with the pelvis and lower part of the trunk elevated on a firm pillow,” and so overcomes the obvious obstacle to drainage. Wagner’s plan is however less objectionable than the practice of Fraentzel† who after making the incision, “as soon as the effusion is, so far as possible, cleared out of the pleural sac, we must proceed to cleanse this cavity, and this we can do by introducing two Nelaton’s catheters, having several openings at their lower ends, as deeply as possible into the pleural cavity, in the direction of the spine, and then through one of these catheters allow pure distilled water of a temperature of 100° to 103° Fahr., out of an irrigator, to run in till the pleural sac is full; then withdraw this fluid again through the other catheter, by means of a double cock exhausting syringe, and repeat this cleansing process until the water withdrawn from the pleural cavity is quite pure. The dressing must be removed twice every 24 hours in the following manner: using the spray all the time we remove the old dressing, and leave only the silver canula lying in the wound. Through this we introduce two Nelaton’s catheters. The irrigation and forcible exhaustion of the fluid from the pleura is then repeated. In two days common salt is added to the distilled water, and after a few days, even if there is no fever, and the contents of the pleural sac are not foetid we should replace the solution of common salt with compound tincture of Iodine, diluted with from 20 to 50 times its bulk of water, or we may use a solution of permanganate of Potash (one grain to the ounce) or a solution of carbolic acid (two grains to the ounce.)”

Morgan‡ maintains that “after removing the purulent contents of the thorax the most effective way of dealing with the suppurative surface of the pleura consists in

* London Medical Record, October 15, 1871.

† Fraentzel. Ziemssen. Vol. 4, p. 719.

‡ Morgan. *Lancet*, March 5, 1881, p. 365.

conveying spray from a Lister's spray producer directly into the chest along a catheter. In this manner the spray diffuses itself through the interior of the thoracic cavity and seems to act less injuriously on the delicate granulations of the pleura than when fluid in considerable quantities is introduced either by the irrigator or the syringe. Before, however, the spray is directed into the sac, all the pus must be entirely removed, and as each syringeful of pus is withdrawn, a solution of carbolic acid must be injected in its place, till all traces of purulent contamination have entirely disappeared."

We give prominence to these statements, as they are among the most recent, and Fraentzel's very distinct directions for the use of the exhausting syringe in order to empty the pleural cavity and "to get the catheters," as he observes, "into the pleural cavity as far as possible, so as to avoid any possible stagnation of pus in its lowest part," clearly show that difficulty of draining does exist when his method is followed, whilst the cases in the appendix should show that the officious anxiety to quicken the return of the pleura to the healthy state, is uncalled for, as this can be best promoted by providing free continuous exit to the contained and perhaps irritating secretions. We consider it only fair to state that Prof. Marshall uses none of these troublesome procedures in ordinary cases.

Campbell de Morgan's operation.—In 1859, Dr. Goodfellow and Mr. De Morgan gave to the Medico-Chirurgical Society an account of a method of treating empyema which they had followed in two cases with good result.* They directed that a puncture with a trocar or a simple incision be made into the cavity of the chest at the usual place—between the 5th and 6th or between the 6th and 7th ribs—or indeed in any convenient situation. A firm long iron probe somewhat bent, is then passed through the opening, and directed towards the lower and back part of the cavity, the lower the better. If the end of the probe be made to

* See *Lancet*, July 2nd, 1859.

press against the sides of the thoracic walls it can be felt from the outside through the intercostal space, though perhaps obscurely, owing to the thickness and toughness of the false membrane within. The lowest and most appropriate site in which the probe can be felt having been selected, an incision is made on the end of the probe, which is then brought through the opening thus made. A straight piece of silk thread is passed into the eye of the probe and drawn through the two openings, and the drainage tube being firmly tied to one end is then drawn through by means of the silk. The advantages claimed are that the openings in the chest wall are always free, the matter is discharged drop by drop as it forms, so that if the tube be suitably placed, there is never any collection of pus in the thorax; no time is given for decomposition, and the pus is therefore discharged in a healthy and pure state.

At a previous page (p. 148) we have related two cases in which the posterior opening was made with much benefit, and, this application of the well-known principle of making a counter opening for improved drainage to the chest, is best fitted for chronic cases, like the couple we have cited. As a primary procedure, the double incision is a serious undertaking, and exposes the patient to the dangers and risk, as it were, of two operations; and is too severe a method to be lightly undertaken, especially in the case of children. The advantages which are said to accrue from it, may be obtained by the less formidable single incision that we recommend.

De Morgan insists that the posterior opening should be made at the lowest part of the pleural cavity, and in which advice the older operators appear to concur. In the American civil war* Guthrie's suggestion "to have the opening as low as possible was appreciated; though most surgeons did not venture on the eleventh interspace behind as advised by him, the tenth intercostal

*Medical and Surgical History of the War of the Rebellion,
vol. 1, p. 581.

space being considered as low a point as was consistent with the safety of the diaphragm." Bowditch* advises that the incision should be made "low down in the back." We have already given reasons for preferring a higher incision (*see page 141.*) Surgeons, fifty years ago, rarely opened the pleural cavity, and when they did so, considered thoracic fistula a satisfactory termination of their cases, and they did not aim at complete cure with cessation of discharge and permanent closure of the wound, which they appeared to regard as almost impossible, if not utopian. In one of the early numbers of the *Lancet*, a surgeon relates with considerable pride, the case of a brother-practitioner, who for three years pursued the duties of his calling, although he had during that time, a discharging sinus leading to an unhealed cavity in the pleura. During the American war nearly all the cases ended in thoracic fistula (a fact which should be remembered in connection with the quotation just given), although "all of those referred to by writers on this particular point were of such a character as to admit only of palliative measures."

At the present day surgeons do not consider their cases cured until permanent closure of the wound has occurred, and modern experience has shown that this result is best attained by early incision above the diaphragmatic surface, appropriate recumbency being at the same time observed.

Bowditch's plan.—Bowditch has given up the use of drainage tubes because, he says, "although there may be a daily free discharge of pus, a quantity may accumulate below the point at which the tube enters the chest." Our experience does not corroborate this statement; as with the use of antiseptics, the purulency of the discharge gives place to serosity, and only when semi-solid curdy matter has blocked the tube has retention of secretions been observed. He observes, "The incision I should generally advise should be

*Bowditch. *Practitioner*, vol. 1., 1873, p. 203.

low in the back instead of in front as advised formerly in books of surgery. The dissection should be made carefully down to the pleura, and the cavity laid open to the extent of at least two inches, perhaps more, provided the free exit of pus can be made more thorough. I shall make no effort to keep out air by valvular openings, because, I know I cannot prevent it from entering and because I believe it will do no harm, certainly, much less harm than any contrivance which, while trying to exclude air, prevents the free passage of fluids out. I shall have that aperture kept freely open by lint until the cavity has fully healed from the interior, if that be possible. I shall use from the second or third day simple warm water or carbolised water injections into the pleura; and I shall let all fluids drain into a large poultice or mass of cotton wadding placed on the chest." We object to the severity of this operation, and we can call to mind a case in University College Hospital, which, after one of the interspaces had been opened for nearly four inches succumbed, apparently from the operative interference. Nor does it appear to shorten the duration of the after treatment, if the case with which Bowditch illustrates his description may be taken as a criterion, for the wound was six months in healing. Again, it involves a gradual dissection down to the pleura, a step which is quite superfluous, and, which if an anæsthetic be used lengthens the operation; or, if the patient elect to bear the pain, prolongs his sufferings. Nor can we discern much additional safety in gradual exposure of the pleura, as the probe pointed bistoury sheathed in the director is prevented from doing harm, whilst the wound made by the former mode has a tender area of raw flesh surrounding it, which, the carbolic acid dressings and solution irritate, which heals by granulation, and is prone to contract before removal of the drainage tube. Marshall makes the skin puncture perpendicularly across the interspaces to counteract the tendency of the skin to be drawn into the wound, but the sides of our incision pass directly into the pleura, and we have not observed the drawback

to which Mr. Marshall alludes. Ward Cousins* has introduced the following method:—"At the point selected I introduce my No. 2 antiseptic trocar, which serves the purpose of an exploring instrument, and then forms the sheath of a probe pointed knife. Under Listerian precautions, the india rubber case is removed, and the inner tube withdrawn; then, in its place the knife is introduced, which accurately fits the trocar, and projects a cutting edge of one inch and a quarter in length. The trocar is thus converted within the chest into a probe pointed bistoury, and with it the required incision can be safely and rapidly made. This modification renders the performance of the operation very easy; on the other hand, an incision from without inwards is often delayed by the dense layer of lymph lining the costal pleura." This mode of opening the chest is but a modification of our own, and which we have practised for several years before hearing of Dr. Cousins' trocar, and whilst admitting that the latter may be useful, we see no reason to discard the more simple scalpel.

Now that the admission of air into the chest does not appear prejudicial, the precautionary valvular opening of old authors to prevent its ingress is rarely made, as its doubtful efficiency in this respect, is more than counterbalanced by the impediment it proves to the outflow of the secretions.

Dr. Lennox Hodge's method† of operating in cases of empyema, and which is followed by "complete success, consists in passing a long curved needle with a stout handle armed with a fine india rubber tube, into the chest through the soft tissues of an intercostal space, and bringing it out through the next space above. The needle is then unthreaded and withdrawn. The drainage tube remains. The spot is covered with a poultice or wad of oakum; discharge occurs freely through the tube, and it is easy to conduct any subsequent treatment."

* *British Medical Journal*, May 27th, 1882, p. 774.

† Meigs and Pepper. *Diseases of Children*, Philadelphia, 1877.

We must confess our non-perception of any advantages accruing from this novel plan or its modifications, whilst the dangers of necrosis of the rib are not, we should imagine, altogether absent. It would be interesting to know whether "the complete success" spoken of by the authors, refers to the operation or the recovery of the patient. The term "respiratory irrigation" has been applied to a theoretically attractive mode of treatment, broached by Mr. Goyder, late House Surgeon at the Newcastle-on-Tyne Infirmary,* but which had been in use and was still being employed at the end of 3 months, the empyema being then uncured. The chest walls are compressed by a Martin's rubber bandage, and a hole being made in the mattress of the bed, the drainage tube passes through it from the incision to a basin placed on the floor. The end of the tube dips beneath the surface of some weak Condyl's solution of which on normal inspiration half a fluid ounce ascends the tube, and on deep inspiration 4 fluid ounces, which expiration drives back.

We refer the reader for the details of the treatment to Mr. Goyder's paper, which is of some interest; but the enforced confinement in bed and prolonged assumption of one position are very cogent reasons for pursuing some other more comfortable plan; whilst the citation of a solitary case which after being submitted for three months to the treatment and was still uncured, acts, we venture to think, more as an argument against than as a reason for adopting this method.

Cresswell Hewett describes a similar plan,† which he terms "continuous aspiration." "Paracentesis being performed with an ordinary trocar and canula, a caoutchouc tube is passed through the canula into the empyemic cavity; the canula is then extracted, and the outer end of the caoutchouc tube is attached to a glass tube, piercing the cork and reaching to the

* *Lancet*, March 5, 1881, p. 336.

† *British Medical Journal*, March 11, 1876, p. 317.

bottom of the vessel containing a weak solution of Condyl's fluid or antiseptic. By gently lowering and raising the bottle the cavity is washed out, and by changing the first bottle for another and similar one, the cavity is evacuated of pus, and filled with antiseptic solution; thus the pressure on the vessels in the walls of the sac is not much, if at all, altered, and hæmorrhage and transudation are prevented. The amount of fluid to remain in the cavity is lessened day by day, by increasing the siphon action of the apparatus by keeping the bottle at a lower level each day than the day previous."

The Injection of Air.—

Mr. Robert W. Parker* laid before the Royal Medical and Chirurgical Society a suggestion for treating cases of empyema, "in which difficulty of removing fluid depends upon rigidity of the wall of the cavity, before free incision, which was a somewhat severe method, was adopted. In tapping, it is *vis a tergô*, rather than *vis a fronté*, which expels the fluid. Either the lung re-expanded, or the diaphragm rose or the chest wall fell in. There were cases, however, in which, owing to rigidity of the chest wall, and binding down of the lung, this expulsive force was reduced to a minimum, and additional means became necessary, in order to empty the abscess cavity. Dr. Bouchut, of Paris, had published a case similar to Mr. Parker's, and had proposed to forcibly expand the lung through a tube introduced into the bronchus. Instead of this somewhat heroic treatment, it was suggested that filtered and carbolised air should be introduced into the pleural cavity, in order to displace the fluid. A suitable apparatus for this purpose was shown, and its mode of use demonstrated. At the completion of the operation, the air in the empyema cavity ought to be somewhat less dense than the external air, so that the lung might be in a position to expand from the first;

* Ibid. May 6, 1882, p. 658.

while the gradual absorption of the air would keep up that advantage during the period of cure. It was contended also that the presence of air in the chest under such circumstances, by supporting the vessels, would tend to hinder the re-accumulation of fluid, which a condition of vacuum, as under ordinary circumstances, would rather tend to promote."

We are averse to paracentesis in empyema, and the difficulties of tapping mentioned by Mr. Parker can be surmounted by the use of the aspirator. The introduction of air into the closed pleura acts as a further hindrance to the expansion of the lung, permanent retraction of which Mr. Parker affirms to be one cause of the non-expulsion of the fluid. And we fail to see what advantage an apparatus, no doubt complicated with valves, can have over a simple trocar, boiled before use, and inserted under the carbolic spray, by which fluid would flow from and carbolized air enter the chest. And, as Dr. Douglas Powell pointed out in the discussion which followed Mr. Parker's paper, "it was a question whether the same object might not be gained by opening the chest wall under the carbolic spray." The air so admitted is aseptic, drainage is provided for, and the pleura placed in the most favourable state for recovery. The plan of Mr. Parker appears to possess the disadvantages of paracentesis for empyema (*see p. 119*). For full particulars of the reasons for and advantages of employing this plan, the reader is referred to the *British Medical Journal* for June 16, 1883, p. 1167, where Mr. Parker describes at length his mode of procedure.

Resection of portions of ribs as a primary procedure we believe to be uncalled for, and unnecessarily severe. The indications and contra-indications for the operation are elsewhere pointed out.

Dr. F. Taylor's modification.—

Dr. Frederick Taylor, of Guy's Hospital,* who was one of the first to practice resection of the ribs, advises

* Articles by Dr. Goodhart. *British Medical Journal*. December 8, 1877, p. 798.

in cases of considerable accumulation, "to remove the pus gradually by the siphon drainage for a few days, and then incise the chest at the end of that time at the seat of the puncture." By this means he does not suddenly withdraw the fluid, and at once lessen the intra-pleural tension. We have never had occasion, or from the results of our operations, seen the necessity for this procedure, which though precautionary against the danger mentioned, exposes our antiseptics to the risk of failure.

Bernard's Operation.—

Claude Bernard and Huette* give the following directions for the operation. "As a rule the opening is best made at some dependent spot in the lower part of the chest and where there are no adhesions. The 9th or 10th intercostal space should be preferred, as lower down the diaphragm might be wounded. In thin subjects it is always easy to mark with precision the place where the opening is to be made as the ribs can be felt and counted. If the obesity of the patient does not admit of the intercostal space being exactly determined the puncture can be made about five fingers' breadth below the inferior angle of the scapula, or about the breadth of three fingers above the cartilaginous border of the ribs. The puncture should be made more behind than in front, close to the union of the posterior third with the two anterior thirds of the circumference of the thorax."

M. Sedillot's Operation.—

In the first volume of the *Lancet* for 1858, p. 267, this surgeon proposes the perforation of a rib with a small trephine of not more than two lines in diameter. A silver canula is introduced which will exactly fill the opening made. When the stream of pus is reduced a fine cork is to be introduced into the canula, and evacuations of pus are to be made every fourth hour

* Text Book of Operative Surgery. Translated by Norton, pp. 244, *et sequent.*

during the first day, the intervals being afterwards longer according to the force of the stream of pus.

But a more recent publication* of French origin thus describes Sedillot's plan. "The incision about an inch in length at the place chosen for the operation. The deep parts are cut to a less extent and layer by layer. When the effusion is not considerable or when it is circumscribed by adhesions, or when the walls of the sac can be easily approximated and brought into contact, the complete evacuation of the pus is not of any danger. But where the empyema occupies the whole pleura, and is very abundant, it is advisable to arrest the discharge of the fluid directly the jet fails at each inspiration, and there is risk of air entering the chest. The surgeon should then place in the wound the middle of a piece of lint, in the *cul de sac* of which some pellets of charpie should be inserted, whilst some cotton wool, and a thick compress, and a bandage nicely adjusted to the body complete the dressings. Two hours afterwards the pus may be again discharged and the operation repeated at the same intervals. A little air often penetrates the chest when the dressings are removed; but this accident need not create any uneasiness, provided that it does not again take place during their re-application. Where, either from want of care or some other cause, the collection of pus discharges itself and is displaced by air, the air may be removed by M. Stanski's air pump, or some other aspirator, and the chest injected with some antiseptic fluid."

Velpeau's Operation.—*

In the case of sanguineous effusion or when the fluid penetrates beneath the intercostal integuments, Velpeau boldly plunges in a bistoury as far as the pleural cavity, enlarging the wound as he withdraws the instrument.

M. Vidal de Cassis' Operation.—*

In the first operation he advises an incision to be first

* Ibid, pp. 245-6.

made through the skin, the subjacent cellular tissue, and the muscles, including the external intercostal muscle. As soon as the internal intercostal muscle is exposed, the operation is stopped, and the wound is filled with charpie, with the view of setting up suppuration. A piece of caustic potash, as large as that employed in making a pea-issue is then placed in the wound. This gives rise to an eschar the size of a sixpence, which is gradually thrown off; while during its separation there is established around the borders of the mortified disc first an oozing, then a discharge which takes place so gradually as to give the lungs time to dilate to the walls of the chest, and the latter to close on the substance of the lungs.

M. Reybard's Operation.—*

This operation permits of the continual discharge of the effused fluid without allowing the air to enter the pleural cavity. Reybard perforates a rib with a trocar, and he allows the canula or the barrel of a quill pen to remain in the wound. The free extremity of the canula consists of catgut or of a tube made of gold beater's skin, which can be made soft, and the advantage of which is, that the fluid in the pleura easily escapes externally at each inspiration (?), while air is prevented from entering the chest by the soft walls of the skin tube collapsing against each other and closing up the end of the canula.

*M. Stanski's Operation.**

The most essential indication is to obliterate and fill up the sac, to prevent the entrance of air into the thorax, and to exhaust the source of the secretions. He makes use of a complex instrument, consisting of a cupping glass, fitted to a trocar, and in which a vacuum can be formed by means of a pump, which completes the apparatus.

*Bernard and Huette. "Text Book of Operative Surgery."
Translated by Norton, pp. 245-6.

Quincke's Operation.†—

He introduces a common syringe between an irrigator and a double tube, which is conveyed into the pleural cavity, so that its longer limb shall be connected with the pipe of the irrigator and its shorter limb with one arm of the double tube. If the tube is carried as deep as possible into the pleural cavity, and the syringe left standing upright in the usual manner; then, as the fluid flows out of the irrigator, the air is drawn through the short shank into the pleural sac; and, in proportion as the air is drawn into the pleural cavity, the fluid in the cavity is driven out through the free arm of the double tube. The fluid will continue to flow out so long as the level of the fluid in the pleural sac remains above the inner opening of the outflow tube; it is advisable, therefore, to bring it to as sloping a point as possible. In the meantime, the syringe has more or less completely filled itself with the irrigation fluid out of the irrigator; and if we now turn it round, while the canula is drawn so far back that its mouth comes close behind the syringe, then the fluid streams out of it into the pleural cavity. The more frequently these manipulations are performed in succession, the more complete will be the cleansing of the pleural cavity, especially if the operator, following Quincke's advice for this purpose, closes the pleural incision, quite airtight by an indiarubber ring pessary.

The practice of evacuating pus with the patient in a bath that the incision may be subaqueous to prevent the admission of air is, save in the case of children, obsolete.

†This description, the first part of which is a little ambiguous, is from Fraentzel's Article on Pleurisy in Ziemssen's *Cyclopædia*, vol. 4, p. 725.

CHAPTER VIII.

WHEN TO OPERATE.

Since the futility of attempting to cure purulent effusions by aspiration or tapping has been recognized, the application of thoracentesis to all cases of general empyema, occurring in otherwise healthy, though perhaps emaciated and debilitated patients, has become general, if not universal. Before incision of the chest was much practised, a purulent collection was regarded as an undoubted indication for tapping, and it would seem that we are now approaching a time when thoracentesis will be considered *par excellence* the remedy for this condition. During this essay we have quoted some of the leading authorities (*see p. 121*) who are all but unanimous in their choice of thoracentesis.

In young subjects—children and youths—the operation is a most successful one. I am aware that in children cure is possible by aspiration, repeated if necessary; but, although the temporary removal of pus may permit expansion of the lung and obliteration of a portion of the suppurating surface, in the majority of cases it will not obviate the performance of thoracentesis, which is equally as safe, and at once rids the patient of the presence of the purulent and exhausting matter.

There are some operations, *e.g.* Lithotomy, whose mortality in the case of children is slight, and among these must be classed antiseptic thoracentesis. In all above two years of age I advise its performance. I have been present during the incision of the chest of a child between 18 months and 2 years of age, and the ultimate result justified the performance of the operation.

In the case of adults no other course but thoracentesis

should be thought of whenever a purulent collection exists, and after the diagnosis has been settled, no time should be lost in evacuating the effusion. There is now no justification for the surgeon to watch the progress of the fluid, nor any excuse to wait for the occurrence of symptoms dangerous to life before making his incision. The mechanical effects of a purulent liquid are as prejudicial as those produced by a fibrino-serous, but to delay operation until the pleura was nearly full, dyspnœa supervened or syncope occurred, can only be characterised as culpable negligence; as the continual daily absorption of pus undermines the patient's health, whilst the formation of false membranes binds down the lung, and more or less interferes with its expansion. The formation of false membrane upon the pulmonary surface takes place during an empyema as well as during the persistence of simple pleuritic effusion, and before cure of an empyema can take place the secreting surface must be obliterated. But, if unfortunately, the lung, overpowered by adventitious membrane, cannot break through and fill the vacant space, which is too great for even collapse of the chest walls to close, that cavity persists, and continued secretion from its surface is sure to occur, and may indefinitely prolong the duration of the case.

Ancient writers assumed that an empyema resulted from the suppuration of the lung, and when on *post-mortem* examination, the pleural cavity was found full of pus, and the lung, diminished in bulk, and functionally inactive, they assumed that the pulmonary tissue had been liquefied and formed the purulent collection in the pleura. We know the incorrectness of this opinion, and cases such as ^{Fig. 10} No. 10 in the appendix and that related at p. 113, where a slab of useless carnified tissue represents the compressed lung, illustrate the type of cases which misled the ancient writers. Such cases are the most unfavourable for operation, for in addition to the possible supervention of secondary disease, expansion of the lung is difficult, if not quite impossible. Early operation, therefore, is imperative, and it is the element of treatment recognized as most essential for success.

Blisters, diuretic, tonics, or any other form of drugging can best be described as "tinkering," and as Allbutt* has satirically observed, resemble an attempt to empty a cask by pouring water over its outside surface. Nor should length of time that the disease has existed, if it be uncomplicated by other affections, deter us from the operation. On the release of the fluid the lung will expand a little, and with time, it may considerably increase in volume, even though imperfectly, and at the expense of a deformed thorax, from which portions of rib have to be removed.

The cases of patients tolerant of their Empyemata are rare, but from the slight discomfort which even a purulent pleural effusion occasionally causes from its commencement, they may be overlooked until the thickened pleura prevents obvious noxious effects upon the system, and the permanent lodgment of the fluid has become tolerated by the surrounding viscera. But cases of long-standing empyema will more often call for operation than expectancy; and we should ourselves much prefer the risks of an operation and the chances of recovery, than the chances of tolerable health and the risks of death inseparable from the presence of fluid in the chest. The discharge of the matter through the lungs and spontaneous pointing through the chest-wall, occurring more often than quiescent persistence of the accumulation, prove that the fluid tends to escape from the pleura.

The state of the patient should be carefully enquired into, especially with regard to the lungs and kidneys. A man, previously healthy and well-developed, may be reduced to a wreck of his former self by pus within one of his pleuræ, and from loss of appetite, hectic with its exhausting sweats and excessive temperature, and loss of flesh, the physician may hastily conclude that his patient is suffering from phthisis. Although emaciation may be very considerable, although the powers of life, overburdened and oppressed, may seem likely to suc-

* Practitioner, 1872, vol. 2, p. 77.

cumb, if no intercurrent or secondary disease be present, the operation of thoracentesis is called for in the loudest tones, and its beneficent effects are seen in the lowered temperature, the returning appetite, and diminished, or more usually, absent hectic. If the patient's state be approaching that known as *in extremis*, aspiration or tapping, as a milder procedure, may remove the pus temporarily, and perhaps allow the failing powers to be re-cuperated by stimulants and nutritive remedies; but, on the other hand, it must be remembered, that if a patient is too feeble to withstand the incision of thoracentesis, as I make it, neither tapping nor feeding are likely to restore departed vitality and strength.

Whilst insisting upon early operation, I must qualify the recommendation by observing that rest in bed for several days before its performance during which the bowels are cleared gently, and, if necessary, good diet prescribed, should be observed. And if in the case of a patient who has been deprived of all but the necessities of life during his illness, improvement in the general condition take place, we may with advantage wait a week before operating. Every case, however, must be judged on its merits, and viewed in its different lights and bearings. Before all operations surgeons are familiar with the good effects of previous preparation, but whilst bearing this fact in mind, and putting its principle into practice in appropriate cases, we must not forget that the pus within the pleura is the cause of our patient's debility and poor condition, and that with its removal improvement may be expected. In hospital work preliminary alimentation and medication will be more frequently called for than in private practice.

There is a class of cases, occurring in weekly pallid subjects, which forms the connecting link between the true émpyema and the simple effusion. The fluid which accumulates is not strictly sero-fibrinous, nor yet absolutely purulent, though upon microscopic examination abundant leucocytes are found in it. It has a general whitish hue, or milky appearance, and is limpid as well as opalescent. It is in fact a sero-purulent collection, and as such may present every gradation

between the sero-fibrinous and the purulent effusion. If it do not smell, and if the milky opalescence indicate that it is not far removed from the sero-fibrinous type, it can be often successfully treated by paracentesis. But should the purulent element predominate, or should it increase after the tapping, then the radical operation should be done without further hesitation.

COMPLICATED EMPYEMATA.

If the surgeon takes charge of an empyema when pointing has commenced, he must still open the chest at the dorso-lateral aspect as recommended, and the tumour formed will then give no further trouble. The position in which pointing most commonly occurs has been alluded to (*see p. 144*) but the pus may burrow through the diaphragm to the abdomen, and (I have I think, read of a case, where, I cannot recollect) may appear as a psoas abscess, and even pass down the thigh; or it may penetrate the muscles of the back and appear in the loin, or above the anterior portion of the iliac crest. In any of the latter instances, the practitioner's diagnostic acumen will be tested, and his resources and ingenuity of treatment taxed. A counter opening at the side of the pointing tumour cannot well be avoided, but on the other hand, unless the source of the escaped effusion be attacked, cure may be indefinitely prolonged, and, although no absolute rule can be laid down, incision of the chest wall as already described, should be in every case considered. Lastly, the empyema may open into the posterior mediastinum and penetrate the œsophagus. Instead of pointing through the chest wall, the pus may be expectorated after passing through the lung, and in some cases it is a matter of difficulty to determine how the fluid has penetrated to the bronchi, as there has been on *post-mortem* examination no sensible breach of the pulmonary surface. There is no doubt that many cases where intra-pulmonary pointing occurs, are cured spontaneously, but my experience of this class of cases has not led me to regard this termination as necessarily favourable. At the late International

Medical Congress Gerhardt, Ranke and Parker spoke, and said they regarded this mode of termination as one of the most favourable, and from the tenour of their observations, I infer that they would prefer its super-vention to the employment of operative measures. Pneumothorax is not necessarily a complication, although, if the case be of some standing it is most usually present; and whenever it is absent I would recommend thoracentesis to prevent its production. This class of cases will become less numerous. They result from delayed operation, and the hitherto unfavourable results of operations for their relief, are owing to the fact that operation has been delayed until the patient is unfitted to withstand it and its results.

SEQUELÆ OF THE OPERATION.

Diaphragmatic Hernia.—

The following notes of this unique case* show the destructive results which may arise from the continuance of pus in the pleural cavity, and although the untoward result cannot be considered a result of the operation, this is the most convenient section of our essay for the insertion of the notes. The patient was a young lady, fifteen years old, whose left chest was aspirated, and several pints of blood-stained pus removed, but as rapid re-accumulation of the fluid occurred, an incision was made in the third interspace two and a half inches below the clavicle. Apparently, perfect recovery ensued. Three years afterwards, after eating heartily of solid food at breakfast and dinner, she was seized with vomiting, and collapse came on. An emetic was administered, and three or four pounds of undigested food were rejected by its action. She recovered from the collapse, which, however, again returned, and the patient died, nothing further having been observed to explain the cause of death. The *post-mortem* examination revealed an aperture in the left

*Reported by Dr. MacNab, *Lancet*, Jan. 5, 1878.

tendinous centre of the diaphragm, large enough to admit the three last fingers, and through it the whole stomach had passed into the pleural sac. The lung, squeezed up to about the size of a hand, was an inch and a half thick. After the operation for the empyema, we are told, that there was no falling in of the side; but for a year before death the young woman had complained to her mother of severe pain high up in the chest, coming on about an hour after meals, and being accompanied with gurgling sounds. "The probability is," adds Dr. MacNab, "that the floor of the chest, thinned possibly by the ulcerative process which went on while pus continued to be discharged, and having no superincumbent lung to retain it in position, was pushed up before the distended stomach, gave way and permitted the hernia."

The case is very fully related by Dr. MacNab, whose narrative will repay perusal, and we think the case precludes comment from us, as its untoward termination may have been due as much to constitutional or inherent weakness of the patient as to the mode of treatment adopted.

Gangrenous inflammation following Thoracentesis—

This is a most unfavourable event, and should be regarded as a sign of depraved constitution. I have never had the misfortune to meet with it, and it seems reasonable to suppose that if the pus be evacuated before it has locally injured the pleura, or damaged the constitution and general health of the patient, the occurrence of gangrenous inflammation is less probable. Antiseptic dressings by admitting aseptic and harmless air within the pleura, may perhaps retard its occurrence in predisposed subjects, but if from any reason its supervention is feared, paracentesis must be substituted for the radical operation, and free stimulation and the administration of those remedies useful in treating patients who have lapsed into a "typhoid state" vigorously pursued. However, should it supervene after thoracentesis the same line of treatment must be adopted. The case mentioned at a previous page (*see*

p. 127), from the practice of Hamilton Roe, should encourage us in our efforts.

Surgical Emphysema and Purulent Infiltration.—

The operation of thoracentesis converts the pleural cavity for the time being into an air receptacle, and the passage of some of the air into the cellular tissue near the wound occasionally occurs. If the wound be made by gradually dissecting down to the pleura, the exposure of the structures of the interspace in layers provides a more ready channel for the passage of the air than do the perpendicular sides of a wound made by one thrust of the knife. It is necessary in operating to remember the possibility of this event, although I have never witnessed emphysematous infiltration. The disposition of the drainage tube is important and it should enter the cavity easily, and permit free egress of gaseous as well as liquid matter.

Extensive emphysema, like gangrenous inflammation, with which it is not unfrequently associated, is an unfavourable occurrence. A case is recorded from the practice of Dr. Ramskill.* It was one of hydro-pneumothorax of some standing, and was treated by puncturing with an ordinary trocar and canula, a drainage tube being left in. The operation was followed by extravasation of air into the cellular tissue around the wound and ultimately into the whole subcutaneous tissue, causing the death of the patient. The reporter of the case adds, the only precautions necessary in the operation are, first, "To pass the needle in horizontally in the centre of the intercostal space, so as to avoid the ribs, for the cases in which surgical emphysema has followed have been those in which the needle has glanced off the rib into the cellular tissue."

The other recommendation relates to wounding the lung and so causing pain.

Dr. Markham Skeritt communicated to the Bristol Medical Society† the case of a man, aged 23, who was

* *Lancet*, August 19, 1871, p. 259.

† *Lancet*, February 16, 1878, p. 240.

admitted into the Bristol General Hospital, with the history of some acute chest attack about a year previously, leaving persistent dyspnœa and cough. The physical signs were those of fluid and air in the left pleura, and of bronchitis and dry pleurisy on the right side. Aspiration was performed in consequence of the dyspnœa, and about $2\frac{1}{2}$ pints of fœtid pus and gas withdrawn from the left pleura. On the second day after extensive subcutaneous emphysema was detected over the back and loins with evidence of the free escape of pus into the areolar tissue. A free opening was made into the pleural cavity and a drainage tube inserted, but the patient died in about six hours. *Post-mortem* examination showed extensive infiltration of the areolar tissue with pus and gas and the lung was collapsed and bound down by false membrane; there was no communication between the lung and the pleural sac; recent pleurisy on the right side, with œdema and congestion of the lung. Dr. Skerritt was of opinion that the pneumo-thorax arose from decomposition in an old empyema.

PROTRACTED EMPYEMATA.

We have endeavoured to describe the course and treatment of empyema where antiseptics are applicable, where the discharge continues "aseptic," and where the progress of the case is consistently towards recovery. If, on incising the chest, fœtid matter flows out, the antiseptic dressings should be continued, unless, after three or four renewals the discharge smell, and the temperature remains preter-naturally high, conditions with which non-improvement of the general state of the patient will be associated. Under such circumstances the antiseptic dressings had better be changed for simpler applications, of which none answer better than lint steeped in carbolic oil, over which a layer of cotton-wool covered by a wad of oakum may be placed. If the oakum be placed next the skin it may irritate it and give rise to an erysipelatosus-like rash. These dressings should be changed twice a day, and free exit for the secretions provided for by a good drainage tube,

which should not project more than one inch into the pleural cavity. If fœtor of the discharge continue it may be necessary to wash out the pleural cavity with some warm antiseptic solution, but before commencing this we should be inclined to adopt measures calculated to improve the patient's health, for which fœtor of discharge is an indication, as well as a result of impeded drainage. Abundance of pure air is one of the most powerful aids in restoring the patient, and its beneficial effects include the promotion of the expansion of the lung, as well as the gain to the patient's health. As soon as the patient can leave his bed, he should be encouraged to do so; and if his strength increase, the duration of time spent out of bed should be lengthened gradually, until gentle out-door exercise—taken with due regard to the state of the weather and proper precautions against cold—can be safely indulged in. At that point in the history of the case residence in the country or at the sea-side is of the utmost value; and, although many cases will permanently recover without removal from home, it should always be the endeavour of the attendant to place his patient in a situation the most favourable for recovery. Good food—for which, in favourable cases, there is sometimes an inordinate appetite—and attentive nursing are in all cases essential, and we allude to drugs last because we believe that they form but a subordinate element in the treatment. Many cases recover without them as soon as the purulent accumulation is taken away, but whenever necessary, they should never be withheld. The most useful are quinine and iron, especially the former. The treatment indeed, throughout, should be a supporting one, and the hypophosphites, Cod liver oil, or even a liberal allowance of wine, beer or brandy may in protracted cases be indicated.

But, notwithstanding, the practitioner's efforts, founded upon a thorough knowledge of the case, and the judicious application of the most approved hygienic and therapeutic principles, together with the most careful dressing, the discharge from the wound may continue; and although the patient improve in health,

although he gains enough strength to take moderate exercise in the open air, a slight nocturnal pyrexia and somewhat capricious appetite, show that his normal bodily health is not regained. The case then falls into the category of thoracic fistula, or of those cases in which the suppurating surface between the walls of the chest and the lung, although diminished in size, is not obliterated. The causes of thoracic fistula may be summarised under three heads, viz.—

1. Prolonged and extreme compression of the lung, rendering it incapable of proper expansion when the pressure is taken away.
2. Rigidity of the thorax.
3. Impediment to the free escape of pus.

Regarding the first of these causes of thoracic fistula, it can be obviated by early operation, and it must be borne in mind that each day's delay means so much more compression of the lung, and a further increase in the strength of the limiting false membrane. We have pointed out that an empyema (*see page*) heals by adhesion of the opposed pleural surfaces, and in many cases, before union can take place, retraction of the bony thoracic wall must occur to allow the approximation of the lining membrane. In the case of children and young adults, the elasticity of the thoracic wall permits this, but in older subjects and some other exceptional cases the rigidity of the thorax prevents its walls from bending. Thus, if incomplete expansion of the lung occur in a rigid thorax, the suppurating surface is not entirely obliterated, and purulent discharge continues. Early operation, therefore, is demanded very emphatically in a patient with a rigid unyielding thorax. We have quoted impediment to the free escape of pus as a cause of thoracic fistula. If a case came to us with an anterior opening, which showed little or no disposition to close, we should unhesitatingly attempt to make a counter opening behind in the seventh or eighth space, after the manner recommended by Mr. De Morgan, a

long probe being inserted through the already existing opening; and when discharge through the posterior wound has become established, the drainage tube should be shortened, so that it projects only through the dependent posterior incision. The anterior wound will then close. If, on the other hand, examination with a probe, show that the diaphragm presses against the chest wall in the region of the wound, squeezing the drainage-tube (which will then act as an irritant), and preventing the emptying of the cavity above it, an incision above the level of the diaphragm, with insertion of a tube, may perhaps do good; and the diaphragm and the lower part of the chest wall, then coalescing, may be followed by contraction of the remainder of the cavity. But if the case be of several months standing, resection of a portion of one or more ribs would be the better practice.

THORACIC FISTULA.

It is in cases of thoracic fistula that intra-pleural injections may be necessary, and whenever, in spite of efforts to the contrary, fœtor of the discharge persists they should be commenced. Boracic acid and thymol are perhaps the least objectionable agents to employ, and one dram of the former, dissolved in half-a-pint of water is the better of the two. Chloride of Sodium and solution of Quinine have been used, and although I never employed the latter, I conceive that not only will it act as a disinfectant, but by absorption will also exert a therapeutic action upon the patient, of a beneficial character. I should, therefore, be disposed to use it, whenever its expense was not a consideration. Injections are conveyed into the pleura more safely by the siphon tube than by the forcible action of the piston of a syringe, and in any case complete distension of the cavity should not be attempted; and if untoward symptoms supervene during the process, the injections had better be permanently discontinued. Barlow and Parker* cite a warm bath as a painless and ready mode

**British Medical Journal*, Dec. 1, 1877, p. 760.

of washing out the pleura in the case of children, carbolic or boracic acid being mingled with the water. On account of the increased fear of syncope, we should hesitate before following this practice. Morgan* speaks well of the use of compressed air in promoting the expansion of the lung, which the patient breathes from an apparatus devised by Dr. Geigel, of Wurzburg. The use of it is founded upon sound reason, but we cannot speak in the matter from personal experience. We believe that a system of "respiratory gymnastics," as recommended by Fraentzel† for diminishing deformity after the wound has closed, is of value in the later stages of most cases, especially in those that have been protracted. Each expansion of the thorax drags with it the lung adherent to it, stretches the pulmonary tissue, increases its air-containing capacity, and assists it to fill the thorax. This hypothesis, we believe, explains the good effects of bodily exercise taken in a pure atmosphere, for increased demand for oxygen necessitates more complete expansion of the chest wall, and consequently a dragging open of the pulmonary cells.

RESECTION OF THE RIBS.

But neither the attentive care of the physician nor sagacious obedience of the patient will suffice to cure some cases; which it will generally be found are those where a large collection of fluid has been for a long period within the thorax. If the thorax, either from inherent rigidity or absolute inability, cannot meet an imperfectly expanded lung, it has been suggested that portions of rib should be removed to allow the chest walls to fall in. Resection of the ribs is an old operation revived very recently, and which increasing knowledge and the early performance of thoracentesis may relegate as unnecessary, to its obsolete position. The Editor of the *Lancet*‡ observes: "There is no

* *Lancet*, Feb. 26, 1881, p. 326.

† Fraentzel. Ziemssen's Cyclopædia, vol. 4, p. 731.

‡ *Lancet*. May 22, 1880, p. 810.

period in the disease, after effusion has taken place too early for the aspiration of the inflamed pleura ; there is no consideration more pressing than the speedy removal of the force compressing the lung. These being our views we look upon such an operation as resection of the ribs as evidence of failure in the earlier treatment of the case. The removal of a portion of rib allows freer drainage than can otherwise be obtained, and no doubt permits of a more complete recession of the chest walls than is otherwise possible, and the bone is eventually reproduced ; but we must again repeat that recourse to it is an admission of failure to obtain a "cure," the effect of which is in many cases as the saving of a life at the expense of a limb."

The operation is thus performed :—The patient being under the influence of an anæsthetic, a T shaped incision is made in the midaxillary line over the ribs to be attacked, and after the periosteum has been carefully stripped off and preserved, the bone forceps, cut out portions of the rib, about $1\frac{1}{2}$ inches in length in the adult and smaller in children. A drainage tube is inserted and the wound dressed with lint steeped in carbolic oil : cotton wool and oakum completing the dressing.

The danger of the operation is hæmorrhage, which can be guarded against by a sparing use of the scalpel when the under surface of the rib is reached. In the event of hæmorrhage the wound must be plugged with Boracic lint, as it will be almost impossible to secure and tie the divided vessel.

The axillary line should be chosen as the best situation from which to take the costal fragments ; for more complete and symmetrical recession of the chest occurs than if a position more anterior or posterior be selected. The experience of operators has not yet been sufficiently great to prove which and what number of ribs should be resected. In children the weakening of one rib has, in the hands of Thomas,* given good

* Thomas. *Birmingham Medical Review*, April, 1880.

results. In adults, however, the removal of a portion of one rib only would not materially assist the collapse of the chest wall, and Marshall is of opinion that four ribs are not too many, and that the sixth is an essential one to deal with. The portions of ribs removed are eventually re-produced, whilst the thoracic conformation alters from the C shape to a more triangular one.

Some German writers recommend removal of a portion of the ribs at the first incision of the chest. I trust that the cases of empyema I append to this essay may prove the absolute non-necessity of this step. If from narrowing of the interspaces there is any difficulty in inserting the tube, then the inferior margin of the rib above should be pared and scraped, as practised by Wood and Marshall, in order to give more room; but to primarily weaken the chest-wall by removing a part of its bony framework, is a barbarous procedure, whose effects will tell upon the patient as long as he lives. I have not met with a case where the drainage tube could not be introduced through the unaltered interspace.

But in cases of long-standing thoracic fistula, where deformity of the chest has commenced, and by approximating the ribs has squeezed the drainage tube and prevents drainage of the cavity, which deformity and the practitioners' skill are incapable to close, the operation is called for, and from the few recorded results, it would seem that the objects of the operation have been attained. The cases to which we would limit the operation are from the duration of the illness, and the continuance of purulent discharge—not favourable subjects for any operation; but, as we insist upon early paracentesis and thoracentesis, so do we deprecate the delay of resection of the ribs until long periods after the first incision. If after six months' treatment the case was not cured, we should begin to think of resection of the ribs, fearing, lest from undue delay, secondary or intercurrent disease might carry the patient off.

The removal of the portions of the ribs, as well as allowing recession of the chest wall, with consequent

diminution of the suppurating cavity, also provides for free drainage; and if the cavity does not close, the improvement of the patient's health and the lessened discharge are sufficient justifications for the performance of the operation. Lest, by too rapid renewal of the bone removed, the cavity should be again blocked, Messrs. Taylor and Howse advise a free removal of the periosteum.*

The subcutaneous division of the costal cartilages has been suggested as an alternative to resection of the ribs. We have no experience of it.

DEFORMITY OF THE CHEST.

To Laennec belongs the credit of first pointing out and grouping the forms of deformity of the chest, and to the operator the subject is of interest on two grounds, first, because it may modify the mode or details of his operation; and secondly, because it materially affects his after-treatment. Deformity after is much more common than before an operation, and we have briefly pointed out the important part it takes in the curative process in protracted cases—

Stokes† draws attention to contraction of a chest containing fluid, and relates the following case—"A boy, aged 19, accompanied a party of soldiers to their firing ground, and received a bullet in the right acromial region. In the course of ten days his symptoms were so urgent as to suggest the propriety of an operation. By some it was considered that a great empyema had formed, but this opinion was by others doubted from the fact that the affected side was greatly contracted. I had no doubt whatever as to the nature of

*Consult on this subject—

Ewald. *London Medical Record*, July 15, 1876, p. 324.

Peitavy. *Ibid*, Aug., 1876, p. 359.

Taylor and Howse. *Clinical Society's Transactions*, vol. 13, p. 19.

Thomas. *Birmingham Medical Review*, April, 1880.

Marshall. *Lancet*, March 11, 1882, p. 382.

† Stokes. *Diseases of the Chest* (New Sydenham Society), p. 524.

the case, as the heart was found pulsating under the right mamma. The operation was determined on. Mr. Cusack and I, taking into consideration the extreme contraction of the side, strongly urged that the puncture should be made at a point higher than that usually selected; we were apprehensive that the diaphragm would be wounded. Our advice, however, was not taken, and the operation was performed in the usual place and in the old manner, viz., by making a free division of the integuments, and then puncturing the sac with the bistoury. In this case no purulent matter followed, and it was then determined to pass a trocar upwards and inwards so as to reach the sac of the empyema. A few drams only of purulent matter followed this attempt, and the operation was evidently a failure. The patient soon after began to sink, and died within a few hours in collapse. On dissection it was found that the capsule of the left kidney had been deeply wounded by the knife, and a profuse hæmorrhage had taken place into the surrounding cellular tissue. More than a pound of blood was thus effused. The diaphragm had been punctured from below but the vast empyema remained." Stokes adds that Sir Dominic Corrigan has confirmed his observations, and that in a case of his if puncture had been made in the usual place of selection, the great curvature of the stomach must have been wounded.

Stokes' narrative lacks one important particular, viz., the point at which the incision was made. We may, however, fairly surmise that the results of Colles' teaching would influence the Irish surgeons, and that the incision was made at the inferior limit of the chest, an assumption which the result of the case justifies. At the present day low incision is the exception, and few modern operators would make an incision over the left kidney. Notwithstanding, if the operation must be performed upon a contracted thorax, the increased proximity of abdominal, as well as thoracic, viscera must inculcate caution, and may necessitate the removal of the point of incision to an interspace higher than that usually adopted. We have not met with

such a case, although we have not infrequently noticed that, when first inspected, the affected side appeared shrunk and contracted in comparison with the healthy one; although the probable condition is the more complete distension of the sound lung, which has to do the work of both. However, such hypotheses concern the the pathologist; and we have to repeat that deformity may follow removal of fluid from the chest—either by absorption or otherwise. Its degree will be inversely proportionate to the expansion of the lung, and its most fruitful cause is delay in releasing the lung from the compressing force. It is, therefore, most frequent in those cases where there is a very abundant effusion, or where there has been long continued compression. Its phenomena, briefly summed up, are general diminution of the chest capacity. The shoulder is lowered, the spine deviates, the ribs are pressed inwards and their margins approximate. It is this last feature of the process that gives trouble by nipping the drainage tube, and also by causing coalescence of the sides of the wound tract, which adhesion of the lining granulations may close. The force which narrows the interspaces is invincible, and working gradually, may cause the surgeon much anxiety. Indeed, until one has personally had the management of an incised empyema, where contraction of the chest and continued purulent secretion go on, the difficulty of keeping open the wound tract cannot be adequately appreciated. If a metallic tube be inserted erosion of the ribs with consecutive necrosis results. The best substitute for the drainage tube is a piece of No. 12 gum elastic catheter, and if by its use drainage is maintained and contraction of the chest is proceeding, we must wait before further measures are adopted. But if there is impediment to drainage resection of the ribs had better be done without delay.

Deformity of the chest, though not perhaps desirable, is one of the favourable terminations of an empyema or other effusion. How many are there who pursue without inconvenience their avocations, with chests malshapen from rickets or other cause, and, moreover, the

deformity after thoracentesis, if the wound have healed, is one which time will annul, if not obliterate. In children and young people it need excite no great alarm; but both in old and young it should ever be remembered that early operation—and that alone—is the great preventive of after deformity, and, that to it we must look for the success of our cases, for the prolongation of lives, and for the restoration of an oppressed and damaged lung.

LARDACEOUS DISEASE.

The last stage of an empyema where long continuance of suppuration, producing perhaps, necrosis of the ribs, has reduced the patient to the verge of the grave, includes the occurrence of lardaceous change in the various organs essential to life. In such cases, operative measures will perhaps have been taken, and the chances of recovery should always be well considered before inflicting upon the patient the incubus of a further operation. Instances, however, will occur to the surgeon of operations undertaken for various diseases and ailments during the persistence of albuminuria, and followed by improvement as soon as the cause of the abnormal excretion has been removed. Once more, however, we decline to lay down a rule of thumb, and rely upon the prudence and sagacity of the practitioner to interpret the indications which in each individual case exist.

NECROSIS OF THE RIBS AS A CAUSE OF EMPYEMA.

Contrary to what one might *à priori* anticipate empyema is rarely due to necrosis of the ribs. The treatment of it is that of empyema originating “idiopathically,” conjoined with the removal of the dead bone, which is the cause of the accumulation, and if by one operation sequestrotomy, with good after drainage, is possible, one incision will suffice.

COMPLICATIONS OF EMPYEMA.

Phthisis.—In discussing the abnormal conditions with which empyema may be associated, it is necessary that

a distinction should be drawn between those cases in which empyema is added to a previous disease and those where the empyema is the starting point.

Especially should this division be made with regard to the relationship between empyema and phthisis, which is the most important and interesting combination which occurs. For on the one hand the experiments of Drs. Andrew Clark, Wilson Fox, and Burdon Sanderson have shown the possibility of artificially producing tubercle, and demonstrated the readiness with which the *materies morbi* is taken up into the system to act injuriously; on the other the septicæmia of phthisis predisposes to what the irritation of the pulmonary pleura by the morbid deposits or the rupture of vomicae, sometimes sets up.

Walshe is of opinion that pleuritic effusions do not materially influence the progress or duration of phthisis, whether they be removed by operation or not. Whilst others believe that the presence and pressure of the confined fluid, by compressing the lung and emptying its blood vessels, retard the growth of the tuberculous or phthisical pulmonary deposit.

The intractability of developed phthisis, its more or less rapid, but none the less sure, advance towards fatality few deny, but a very limited range of experience suffices to teach us the wide differences between individual cases, especially with regard to the progress of the disease. In the acute, by which I mean the more rapidly fatal cases, the operation of thoracentesis should not be performed until after the most mature deliberation, as it may hasten the fatal issue, and the less formidable paracentesis will be better borne, and for the time being, will relieve the patient. It is, however, in the slowly progressing cases of so-called chronic phthisis that thoracentesis may not only relieve subjective symptoms, but improve the condition of the patient, as well as retard the rate of the pathological changes in the lung. It not unusually happens that the phthisical change occurs at the apex of the lung on the opposite side to the empyema, and in such case the removal of any fluid which oppresses the sound lung, and by

maintaining the hyperæmia of the other hastens the rapidity of the local phthisical changes, is demanded. Much more so indeed is the evacuation of a purulent collection called for, and thoracentesis has, in one case which was under my supervision, proved a valuable adjunct of treatment, both by the removal of the pus from the system as well as by its beneficial influence upon the lung mischief. The condition and vigour of the patient are in every instance to be taken into consideration, and the extent of the ravages of the disease will influence us in operating: extreme emaciation and asthenia will contra-indicate anything more severe than paracentesis, whilst the gradations between this state and health will permit the operation to be performed, after the intelligent deliberation of the physician in each individual case.

Cases of empyema occurring during phthisis upon the affected side are most frequently the result of broken-down pulmonary deposit, being cast into the pleura. The irritation they set up induces the purulent formation, which may, however, be of very insidious growth, is often complicated by pneumo-thorax, and in the long run, if unrelieved, will terminate in the production of a pulmonary, and perhaps a bronchial, fistula. Or pneumo-thorax may also be one of the accompaniments of the effusion, when first formed, and may pass away, leaving unmixed pus. In these cases the best rule undoubtedly is that which inculcates operation, although the results will not be so favourable as in the class of cases just alluded to; and, moreover, the operation in advanced cases is a very fatal one, and in two cases in which I saw it done, death in one occurred in twelve hours, and in another (case 10 in appendix) in two days.

There is no doubt that the fear of tubercle or phthisis setting in is greater during the persistence of a purulent than a serofibrinous effusion, but lest this statement should unduly stimulate the commencing operator I must at once confess my belief—one indeed which I at first somewhat unwillingly held—that the supervention of phthisis or tuberculosis during a primarily formed

pleuritic effusion is very rare. I have watched two cases of general tuberculosis, with abundant effusion into the pleural cavity, and although perhaps in both during the early stages to have diagnosed tuberculosis would have been hazarding a guess, the nature of the affections was not long in doubt, and a deposit of tubercle must have preceded the outpouring of the fluid. I have also witnessed in the *post-mortem* room examples of long standing and abundant effusions, both purulent and non-purulent, which had squeezed one lung to a kind of flat cake, and left the other congested but otherwise healthy. On the other hand I have never seen phthisis developed during the course of any pleuritic effusion. Although it is undoubtedly a safe practice to dread the occurrence of phthisis during a pleuritic effusion, unless phthisis be present it should have no influence upon our operations, and we must look to other indications than a fear which writers have been eager to magnify, and which I believe to be nearly groundless. Flint records* that of 22 cases of pleurisy preceding phthisis (out of a series of 670 cases) in exactly one half the phthisis followed immediately or very quickly; of the remainder in two only was the phthisis less than a year in developing, and in the majority of them, more than two years. In another place the same writer observes† that of 47 cases of chronic pleurisy, in one only was the development of phthisis certain. Of 53 cases of pleurisy observed by Dr. Blakiston, not one became phthisical after the lapse of several years after recovery.‡

Phthisical cavities sometimes extend to such a size that they may be fairly denominated a variety of intra-thoracic effusion. The conception to tap and drain them has been carried into execution by several operators independently,|| and when one remembers that

* Phthisis, by Austin Flint, M.D., p. 59.

† *Buffalo Medical Journal*, Nov. 1852.

‡ Practical Observations on Certain Diseases of the Chest, 1843.

|| Solomon C. Smith. *Lancet*, 1880. Douglas Powell
British Medical Journal, June 19th, 1880.

some are heroic enough to attempt the extirpation of the lung in the lower animals, believing that they may survive,* the boldness of the procedure is less startling. The attempt to treat an abscess of the lung by drainage is to apply an old principle to pulmonary surgery, but the difficulties to be surmounted, comprise the manipulations of the operation, as well as the impossibility of precise diagnosis. The difficulties are comparatively insurmountable when dealing with vomicæ at or near the pulmonary apices, and become less as the basal region is reached. Occasionally an excavation in the lower part of the lung, attains considerable size, and is capable of holding fluid enough to simulate a pleuritic collection. Such cases are the most favourable for incision and drainage, and I have lately assisted Dr. T. Kilner Clarke to put a drainage tube through the posterior aspect of the chest into a cavity in the lower pulmonary lobe. He had, on a previous occasion, tapped and successfully drained a small cavity in the anterior portion of the lung, but the physical signs of a large pus-containing cavity, freely communicating with a bronchus, were present behind. Ether having been administered, this was incised and drained; the man gained two stones in weight, appetite returned, his cough diminished, then disappeared, and instead of bringing up as much as a pint at a time of very foetid matter, the patient has now no expectoration, and after being bedridden for a considerable time, was enabled to get up and go about well; the wound being quite healed. He has now returned to work. That the case was one of phthisical cavity, and not one of limited empyema was plain, for the illness began gradually, and the patient had been treated for commencing phthisis, by a competent practitioner in another town, who sent him to the seaside. There was not the least displacement of the heart at any period of the illness. At the present time, 13 months since the operation, impaired resonance is

* Gluck—Schnid—Marcus. *Lancet*, December 24th, 1881, p. 1098

the only perceptible trace of the previous cavity. That in such a case, the practice is justifiable and advantageous none will doubt, but it will require a stout heart, a confident hand, a delicate ear, and acute diagnostic acumen, to successfully cope with a phthisical cavity in the superior parts of the lung in a similar manner. If the limits of my paper permitted and time allowed, I should wish to discuss more fully the treatment of phthisical cavities by direct drainage.

Empyema, like simple effusion, may complicate any disease, and its treatment must be conducted according to the rules laid down, modified according to the exigencies of each case. Wherever admissible, there is no doubt but what the radical operation of thoracentesis is the most successful procedure. A purulent effusion may be thrown out during the course of acute pneumonia,* and although aid should not be withheld, if necessary, during the acute stage, it is more probable that it will be required after the subsidence of inflammatory symptoms. During the height of the disease paracentesis only is permissible, but afterwards thoracentesis is the better practice.

An aneurism may co-exist with an empyema, and cases of pulsating empyemata, which although more often the simulators of an aneurism, owe their character sometimes to the presence of an aneurism.

In pyæmia and desquamative nephritis, empyema is apt to be overlooked, but when detected tapping or aspiration will be advisable. In the milder forms of pyæmia, or when the effusion appears in the course of a protracted after-illness, thoracentesis may, however, be admissible.

Peritonitis may accompany the pleural inflammation, and pus within the abdomen may form at the same time as an empyema. This may suggest communication between the pleural and abdominal cavities, and in a reported case,† the injection of a solution of

*See *Lancet* Dec. 16, 1876, for interesting case.

† *British Medical Journal*, vol. 2, 1880, p. 884.

carmine into the pleura was practised to determine the point.

There is one complication which may mislead, viz., the occurrence of a superficial abscess on the surface of the chest wall, which does not communicate with the collection within. The surgeon may have diagnosed the effusion, and if he first incise the pointing swelling, he may either accept the small quantity of pus discharged as convincing proof that his diagnosis is at fault, or may assume that the empyema has been tapped,* both of which conclusions from the patient's point of view, are disastrous. If, therefore, after opening the chest at the point recommended, any superficial swelling do not disappear in a few days, it may be incised, and if no communication between it and the empyema exist, it should be regarded as an abscess, to be treated on antiseptic principles.

LIMITED AND LOCULATED EMPYEMATA.

Thus far our observations have referred to gross general effusions of pus, but the consideration of those smaller collections—variously termed encysted, unilocular, circumscribed or limited empyemata—remains. Some of these from their position, even if discovered during life, preclude any operation for their relief. Thus Parker and Barlow† have found an empyema going round the root of one of the lungs, and closely simulating in percussion signs a mediastinal tumour, an inspissated empyema around the apex of the lung, an encysted collection upon the diaphragm, and one situated between the anterior edge of the lung and the pericardium.

With such deeply placed effusions we are unable to cope, and the class to which I refer may be illustrated by the description of the following case:—

Mary Lee, aged 56, a charwoman, who was dependent

* See case by Dr. Whipham. *Lancet*, Dec. 21, 1878, p. 881.

† *British Medical Journal*, Dec. 1, 1877, p. 759.

for her livelihood upon her own exertions, was seen by Mr. Brewer, Surgeon to the Huddersfield Infirmary, on the morning of November 28th, 1881, and who, as the attentions and requisites for the treatment of one evidently so seriously ill, could not be obtained in the patient's humble home, at once ordered her removal to the Infirmary. She was admitted at noon and told us that with the exception of transient, though severe, pains in the side of the chest, she had been as well as she usually was until the previous night, when suddenly difficulty of breathing and severe pains in the left side came on, and she was obliged to spit up a great deal of phlegm. On admission she could not lie down, the respiration rate was 50 per minute, pulse rapid and feeble, skin hot and sweating, general appearance very anxious and depressed, with slight cyanotic tint in the face. An examination of the chest, beyond revealing general large moist râles on the whole of the left side, with similar, though less marked signs on the other side was negative. There was no appreciable dulness even on very careful examination. The patient was spitting up frothy muco-purulent sputa in which the purulent element largely predominated, and which she bitterly complained she could not get up. The case was by no means a clear one. Stimulants and stimulating expectorants were prescribed, but the cyanotic condition increased and the patient succumbed on the following day. On *post-mortem* examination, the lungs were found healthy, though congested with dark blood; and in addition the bronchi and bronchioles leading to the posterior surface of the left lung were bathed in semi-purulent discharge. The pleural layers at about the middle of the posterior thoracic wall were adherent in such a manner that they enclosed an oval cavity the size of a large egg, one wall of which was formed by the surface of the lung. The cavity contained a few drachms of pus and communicated with the lung, by an irregular opening half-an-inch wide in its longest diameter. It was, indeed, an encysted empyema which had burst, and the continued discharge, which the movements of respiration forced into the air passages

by compressing the abscess sac, had flooded the lung and suffocated the patient. Now had previous physical examination of the chest revealed this small abscess, an incision on its parietal surface would probably have saved the patient's life.

Dr. Wilks* has pointed out the comparative frequency of encysted empyemata after an attack of acute pneumonia as well as given a warning against their dangers; and the knowledge that these little purulent collections form, should inculcate care and method in the physical examination of the chest, for the sudden flooding of the lung with a purulent fluid is dangerous to life, and if it occur, allows little hope that our services may be of use, as the emptying of the tumour will deprive us of the means of ascertaining its position.

When diagnosed by physical signs, the correctness or fallacy of the opinion should be proved by the exploratory syringe, and if pus be withdrawn by it, an incision in their centre large enough to admit a capacious drainage tube should be made. They are to be treated exactly as abscesses in other parts of the body, the antiseptic mode being adopted. The abscesses may be numerous, and each should be treated as described. In the circumscribed empyemata, Marrant Baker's tracheotomy tube is excellent as a drainage tube, as indeed is the silver instrument as well.

Morgan† affirms that in cases of multiple limited empyemata the point of incision can be determined by the temperature of the skin.

There is a form of empyema, which in contra-distinction to the group of cases just specified may be termed multilocular, and consists of one large empyema divided by septa or bands into numerous and less distinct pus containing cavities. On operating upon such a case the object of the operation will not be attained until a

* *British Medical Journal*, June 21st, 1879, p. 929.

† *Lancet*, March 5th, 1881, p. 365.

free exit be given to the pus in each loculated cell, and for the purpose of breaking down the dividing membranes, the finger or a long firm probe or canula may be introduced. If the majority of the septa be torn through the suppurating process and expansion of the lung may dissipate those that the probe has not touched. In every case, where a deliberate diagnosis of the withdrawal of a small quantity of pus, has called for thoracentesis, if on operating very little pus flows, the finger should be inserted within the chest to determine the existence or non-existence of this condition.*

The tardy escape of pus upon operation may be due to the abundant accumulation of curdy or flocculent material, which also may require the introduction of the finger to thoroughly remove. This practice is preferable to that of endeavouring to wash out the semi-solid material with injections.

EMPHYEMA FROM THE INTRODUCTION OF A FOREIGN BODY.

In civil practice emphyema, resulting from the lodgment and irritation of a body within the pleura, is not so common as in military surgery, and in the section on hæmothorax, we shall consider the immediate treatment of those cases where a missile or portion of projectile has penetrated the chest.

The cases which come under this head may be divided into two groups, viz.—Those in which there is previously no breach of the thoracic wall and those in which an opening exists.

Of the former, the ordinary bullet or shell wound may be specified. But it does not necessarily follow because a foreign body has penetrated the chest wall, that emphyema will set in. The missile may have passed on to the lung, and there become embedded, and a number of authentic cases is on record where

* Consult on this point Fraentzel, Ziemssen's Cyclopædia, vol. 4. Morgan, *Lancet*, February 25 and March 5, 1881. Darwin, *Lancet*, September 23, 1882.

apparently the bullet did no harm, and became ultimately encysted. Manec* reports a case of a piece of iron remaining harmlessly in the chest 15 years, Nisle† gives one of a bullet remaining 16 years, Moore‡ relates a case where a bullet lodged near the surface 50 years, Arnott|| removed after death a hoop of iron from the left lung, where it had been 14 years, and in the Museum of the College of Surgeons§ may be seen a bullet taken from an abscess in the chest of a man who had been hurt at Waterloo 42 years 117 days previous to death. We refer our readers to works on Military Surgery for further information, and especially would we commend to notice the Surgical Volume of the "Medical and Surgical History of the War of the Rebellion in America," p. 580, *et sequentur*. An empyema may result from the inflammatory state which a foreign body suddenly thrown into the chest may set up, although the body may not be near the pleura. In every case, therefore, physical examination should be adopted as a matter of routine, for these traumatic empyemata fill the chest very rapidly, and early operation must be the surgeon's maxim. With regard to search for the bullet or missile, we shall refer to the subject hereafter.

We have now to allude to those cases where a foreign body enters the chest through an opening already made. The bodies are usually pieces of dressing, portions of instruments or drainage tubes, and their escape into the chest occurs when the case is under the surgeon's care. He, therefore, is responsible for these accidents, and should guard against them. We have pointed out how to obviate the permanent escape of the drainage tube; and with regard to instruments which may be inserted into the chest, the surgeon

*Manec. *Bulletin de la Société Anatomique, Paris*, 1829, p. 51.

† Nisle. *Archives Generales de Medicin*, 1831, T. xxv., p. 253.

‡ Moore. *Lancet*, Jan. 9, 1847.

|| Arnott. *Medico-Chirurgical Transactions*, vol. 13, 1827, p. 281.

§ Leash. *Catalogue of the Museum of the College of Surgeons*.

should not fail to ascertain before-hand that they contain no flaw.

Mr. A. E. Durham* relates a case, which, after operation, as the discharge did not flow freely, was treated by substituting carbolised lint for the drainage tube. A violent inspiratory effort drew it into the wound, and Mr. Durham had constructed a special form of forceps, by which he extracted it from the pleura.

At the Charing Cross Hospital† an empyematous chest was being drained by a piece of catheter $2\frac{1}{2}$ inches long, secured by a thread tied to the outer end, when, owing to some unusual movements of the patient, the threads were broken. In extracting it Mr. Bloxam made an incision parallel with the upper border of the eighth rib, and passed a bent probe into the pleural cavity. By a little manipulation the tube was felt, seized, and successfully extracted.

Other cases have no doubt occurred, and three have come within my own notice, of which the first is that mentioned in the appendix, where an aspirator needle broke. The second was one in which the ivory nozzle of a syringe with which the pleura was being washed by an eminent and well-known London surgeon after the operation was lost. The original incision was extended to search for the portion of the syringe, but without success, and the patient made a good recovery, subsequently attained robust health, resumed his occupation as a sailor and made the voyage to Demerara and back twice, and when last heard of was in good health, although he carried the piece of bone in his chest. In the third case a piece of indiarubber drainage tube, to which no strings had been attached nor other precaution taken to prevent its disappearance, slipped into the chest, and the patient passed through a long, tedious course of suppuration. The tube was never recovered, although search was made; and I believe the patient succumbed to the effects of the long-continued suppuration.

“Preventive medicine” is a term which the physician monopolises; but there are not wanting examples

where "preventive surgery" would be apposite in application, as well as beneficent in practice. The little measures taken to prevent the disappearance of the drainage tubes during the treatment of empyema would come within the scope of this term. They should never be omitted, and the surgeon should personally examine the tube to see that the strings are securely attached. For although the antiseptic dressings prevent the free ingress of air into the chest, a deeper inspiration during their removal, or even when they are in position, may draw the tube into the wound. But if the safety strings are attached it can be readily pulled out, and its disappearance need occasion no anxiety. Towards the termination of a successful case the tube is often thus drawn into the chest. If, however, a loose foreign body pass into the pleural cavity by the thoracentesis wound, no time should be lost in attempting to remove it, whether it gives rise to unpleasant symptoms or not. In many cases it will be recovered, and alteration of the position of the patient may cause it to gravitate, and bring it within reach, when much will depend upon the dexterity and ingenuity of the operator. An anæsthetic should be administered, and the success of the operator's first attempts must guide him in determining the advisability of further incision, whose direction and extent the position of the foreign body, if it can be ascertained, will decide. If the substance cannot be felt or discovered, an incision near the lowest part of the chest, as recommended by Guthrie, is perhaps preferable to extension of the original wound; the finger being placed within the chest through the original wound, to act as a guide and director to cut down upon. If the tube or body cannot be found, the prudent surgeon should cease his search, and hope that it may have become encysted, as occurred in the examples we have quoted at the head of this section of our subject.

CHAPTER IX.

THE OPERATIVE TREATMENT OF PNEUMOTHORAX.

Pneumothorax is the name given to a collection of air in the pleural cavity, and the term is usually applied only to those cases where there is no communication between the confined air and the external atmosphere.

In March, 1882, Dr. Geo. Johnson read before the Clinical Society notes of the case of a school boy, who, after running about twenty miles in a paper chase, was, two days later, suddenly seized with pain, urgent dyspnœa and prostration, after running upstairs. He was sent to bed, and on the following day all the signs of pneumothorax were present on the left side. The temperature remained normal, and although the left side of the chest was everywhere hyper-resonant, except in the interscapular region, in two months' time the only difference between the two sides of the chest was a doubtful flattening and diminished respiratory movement in the left subclavian region. Rest in bed and simple diet was the treatment adopted. An interesting discussion followed the recital of this case, but we cannot give it at length here.* Dr. Johnson referred also to other reported cases.

Let me now, by quoting another case, exemplify a different variety of pneumo-thorax.†

A boy, aged 9, was admitted into University College Hospital on 20th Sept., 1860, having been run over. There was found to be intense general emphysema of

* *Medical Press and Circular*, March 1, 1882, p. 185.

See also Mackenzie, *Lancet*, 1871, vol. 2, p. 259.
Wilks, *British Medical Journal*, 1874, vol. 2, p. 770.

† *Lancet*, December 1, 1860.

the whole body, and on percussing the chest, there was evidence of marked pneumo-thorax over the right side, and slight over the left side. When the patient had almost ceased to breathe and the pulse could only be discovered with difficulty fluttering at the wrist, Mr. Bastian punctured the chest with a small trocar on the right side, between the fifth and sixth ribs. On withdrawing the trocar there was a rush of air through the canula, which continued for several seconds, and was followed by immediate relief of symptoms—the child began to breathe deeply and the pulse became tolerably strong and full. Ultimately, however, it sank. On post-mortem examination the lungs were found not more collapsed than usual.

One other form of the disease remains to be instanced, where for example, the rupture of a vomica permits the escape of air into the pleura from the lung.

For other and rarer types of the affection surgical interference will not avail much, and we may confine ourselves to the consideration of the three forms we have adduced, premising our remarks with a short survey of the influence of the atmosphere upon the pleural membrane. In investigating the matter a very sharp distinction must be made between the presence of air only and of air and other extraneous matters together, as the former is nearly innocuous compared with the effects of the latter combination.

Two facts must be admitted as proven, namely, that air alone within the pleura exerts no influence beyond a mechanical one, and that air is absorbed by the pleural membrane. Guthrie* observes that "Dr. Hughes has published several cases of pneumothorax in the eighth volume of 'Guy's Hospital Reports' for 1852. In one case, which he calls a genuine example of pneumothorax, from rupture of one or more of the vesicles of an emphysematous lung, the patient died speedily; and, on examination," he says "it is also an interesting fact that no evidence of inflammatory action

* Commentaries, p. 427.

existed in the pleura, as it indicates that air in the healthy serous membrane does not excite inflammation—a Peninsular dogma I have been forty years inculcating, and which, I trust, is at last admitted as an established fact. How long it may be before it is generally taught, is another matter; for surgeons, like other men, often adhere with tenacity to preconceived opinions, however erroneous, particularly as they advance in life, and have ceased to desire to learn more than they already know.”

At the present day, as Guthrie observes, it is not generally taught, that air within the chest does not excite inflammation. The case with which I have commenced this section of my paper is an addition to the accumulated stock of affirmative evidence, if not alone a convincing proof of the statement I make. The absence of inflammation of the pleura accounts for the non-formation of false membrane upon its surface and around the lung, and consequently the pulmonary structure, unhampered by the resistance of a tough leathery case unfolding, keeps pace with the absorption of the accumulated air. It is the absence of false membrane which renders the treatment of uncomplicated pneumothorax more satisfactory than of a liquid inflammatory effusion, and teaches us that whilst symptoms of urgency do not supervene we may patiently postpone the performance of paracentesis. For if time be given the intra-pleural pressure will close the valvular aperture through which the air passed out of the lung, which will then in all probability permanently heal. Absorption of air will then begin. If the pleural membrane cannot absorb air, how was its removal effected from the well nigh filled pleura of Dr. Johnson's patient? We may answer the question by one of three guesses. Firstly: That the air transudes directly through the serous sac. Secondly: That the pleural secretion dissolves the air, and the solution is then absorbed, or Thirdly: The air is removed only by the pulmonary surface, whence it rapidly passes into the lung. And when we bear in mind the amount of pressure upon the surface of the lung, forcing the air as

it were from the pleura into its structure, in accordance with the laws of endosmosis, and also recollect that pus, as well as serum, travels from the pleural cavity to the bronchi without perceptible breach of the pulmonary surface, the probability that this is the explanation is forced upon us.

The knowledge we have gained, therefore, inculcates that hasty evacuation should be the exception in simple pneumothorax; and except in cases of urgency an expectant line of treatment should be adopted.

In these cases non-interference should be the rule; perfect rest in bed, and simple diet will suffice to cure most cases.

In the next class of cases—traumatic pneumothorax—where extensive injury to the thoracic viscera may coincide with severe damage in contiguous or other parts, pneumothorax is generally associated with surgical emphysema. The air may accumulate and increase very rapidly, and give rise to very urgent symptoms. In such case, prompt relief, by letting out the air through a small canula, is imperative. I have, however, seen more than one case where considerable displacement of the heart existed, when rest in bed and careful nursing sufficed to tide the patient over the dangers of an abundant collection. If a wound pass into the pleura, the surgeon should not be too anxious to close it, especially if cellular emphysema be present; nor in the case of fractured ribs should compression of the chest wall by strapping be continued, if dyspnœa or discomfort of the patient be thereby increased.

Pneumothorax from rupture of a vomica is the commonest form of the affection, and it may be a matter for speculation whether in the “idiopathic” pneumothorax, some spot in the lung weakened by a local morbid process or pathological deposit does not give way under the strain of muscular exertion. Perforative pneumothorax, as a sequel of lung disease, may set in during almost any pulmonary disorder, but it is in cases of phthisical degeneration of the lung that it most commonly supervenes. In such case, it may visit without attracting the attention of the patient; or it may be caused by the efforts of

coughing or straining at stool, during which a sensation as of something giving way in the chest may be perceived. The opening through which the air gains ingress to the pleural cavity, may communicate through the vomica as a patent hole with a small bronchus; or may exist as a small aperture covered as by a valve by a flap of the pulmonary pleura. If caseous particles or blood drop into the pleura, whilst the air is within the cavity, an empyema, the pus of which is generally ichorous and unhealthy will result, and the condition known as pyo-pneumo-thorax be set up.

The treatment of phthisical pneumothorax by operation is not often adopted, as it undoubtedly appears to exercise a controlling influence upon the progress of the disease, and the reader will recall cases of patients who have lived very considerable periods, with effused air in their chests. If the quantity of gas increase and difficulty of breathing come on, the air may be let out in the manner described. Dr. Eade, of Norwich,* relates a case where this was accomplished with good result.

PYO-PNEUMO-THORAX.

But the occurrence of pneumothorax during phthisis is frequently accompanied or closely followed by the effusion of liquid, and a much more grave condition is then induced. Laennec,† to whose thoughtful chapter we refer the reader, observes:—"Pneumothorax with a liquid effusion, and still more with a pulmonary fistula, is a case of most serious nature, and leaves little hope for a cure being effected. This, however, must not be considered as quite impossible, even in the severest cases. I think we ought never to attempt this operation (paracentesis) in such cases, unless there is imminent risk of suffocation or rapidly increasing emaciation and debility, and never after the long

* *Lancet*, August 25th, 1877, p. 279.

† Laennec. "Diseases of the Chest," p. 524.

continuance of the disease, unless the lung on the sound side gives no indication of tubercles."

With regard to operation, I must confess to a very great distrust and a loss of confidence in both paracentesis and thoracentesis in cases of phthisical pyopneumothorax. I have performed thoracentesis or been present during its performance in four cases, and in all a speedily fatal termination resulted. Prior to the operation, the patients were, though losing ground, in tolerable comfort, and doing comparatively well; but afterwards loss of strength and general prostration soon put an end to the cases. The complication is most frequent in the later stages of the disease, when from debility the patient is less able than at the commencement of the disease to withstand the additional strain of operative procedures. On the other hand, I have, as already hinted, met with patients, supporting without great inconvenience a phthisical lung and a complicated effusion into one pleura. My opinion, however, must be received with the reservation with which all "absolute" statements should be qualified; for, although I have not seen such a case, I can conceive that in an early stage of phthisis the operation undertaken for such a condition might be followed by encouraging success.

The teaching of the last paragraph would seem in opposition to the views I hold and have expressed respecting the treatment of uncomplicated pleural effusion occurring during the course of phthisis. I believe that, however, a very sharp distinction must be drawn between the two classes of cases, and as they differ in origin, so also is a different treatment required, that which is often successful in the one, being of little utility in the other.

Laennec* mentions two cases of double pneumothorax, and his opinion that such cases are beyond all the resources of both nature and art is no doubt correct, although, promptly undertaken paracentesis, in an early

* Laennec. Diseases of the Chest.

stage of the affection might hold out prospects of relief, if not of cure.

Pyo-pneumo-thorax occurring during phthisis cannot *per se* be deemed more than an element in the course of the phthisical events; but cases are not infrequently met with where pyo-pneumo-thorax is the only discoverable lesion. Such cases are as a rule of long standing, and have generally started as simple empyemata or pleuritic effusions, the continuance of which within the chest has caused thinning and rupture of the pulmonary pleura, with eventual effusion of air. The liquid in the pleura usually penetrates the lung and is spat up; but it must not be inferred because copious purulent expectoration and empyema co-exist that a free communication between the pleural cavity and the pulmonary interior is present. I have in more than one *post-mortem* examination searched in vain for breach of the pulmonary pleura, to explain the copious purulent secretion which had been discharged in the expectoration of a patient suffering from empyema. Stokes* lays stress upon this point, and quotes the opinions and conclusions of Drs. Green and Hutton in support of it. Indeed, copious purulent expectoration may occur in cases of empyema, uncomplicated by the addition of air.

We must, therefore, look to other means of determining the condition, and it must be observed that its signs are very equivocal, and much will rely upon the practitioner's experience as also upon his perceptive ability of the refinements of thoracic diagnosis and physical examination before he will be warranted in treating such cases.

Eliza Dyer was admitted into the Leeds General Infirmary, under the care of Dr. Clifford Allbutt on 28th May, 1880. Her illness commenced with sickness and slight shivering two months ago. She does not appear to suffer much, and eats well. On the left side of the chest there is complete dulness behind below the

* Stokes. Diseases of the Chest, p. 524.

sixth rib, and loud gurgling sounds are heard all over the same side, especially at the base. She is spitting up six ounces of pus in the 24 hours. She was examined by several well-known physicians and surgeons, and the diagnoses pneumonic breaking down, phthisical cavity, and pyo-pneumo-thorax were all given. She was discharged relieved. Re-admitted on September 24th, 1880. There is now no dulness in front. Breath sounds of a good character, audible all over the left chest in front, and accompanied everywhere by high-pitched metallic "ruttlings," which disappear entirely after vigorous coughing. Laterally there are the same physical signs as in front. Posteriorly, there is general impairment of resonance from apex to base, and from the lower limit of the lung to about ninth dorsal spine there is absolute dulness, or nearly so. Above the upper limit of the absolute dulness breath sounds accompanied by the metallic "ruttles," are everywhere audible. At upper limit of dulness and in the transitional area, so to speak, from comparative to absolute dulness, there is a small patch situated over the body of the lung, about the size of an ordinary stethoscope shield, over which the râles are constant and apparently nearer the surface, and here the voice presents the most marked alteration there is to be found—it is absolutely pectoral and almost œgophonic. Over the absolutely dull area the breath-sounds are diminished, and for the most part râles are absent. There is no rise of temperature, and the chest was twice explored over this dull area with negative result. Purulent expectoration continues. The notes of this case, shorn of unimportant details for brevity's sake, will suffice to show the uncertainty which hangs over the diagnosis of pyo-pneumo-thorax in some cases, and phthisical cavities, gangrene of the lung, empyema with a congested or bronchitic lung may be mistaken for it. In the case of considerable purulent collection, succussion is a reliable sign, but the most convincing proof is the withdrawal of pus by the exploring syringe.

The physician must also remember that pyo-pneumo-thorax may be superadded to any of the conditions to

which we have referred as complicating the diagnosis. A phthisical cavity may burst into the pleura, or a gangrenous process lay bare the pulmonic structure. In exceptional cases, the air admitted to the pleura may set up a gangrenous inflammation. Thus, a case of empyema is reported,* in which, 21 days after the operation, the discharge became very offensive, and an ulcerative process commenced, which destroyed the pleura costalis, intercostal muscles and skin from within outwards, and produced several large holes on the anterior surface of the chest. Ulceration increased, the legs became œdematous, mouth aphthous and holes in the chest bigger, and the patient died three months afterwards, with sudden acute pain in abdomen and side of the chest. No *post-mortem* allowed. It is, however, where there is some pre-existing inflammatory process that gangrenous inflammation from the ingress of air takes place.

It would be out of place, as well as tedious, to enter more fully into the question of the diagnosis of pyo-pneumo-thorax. Whenever pyo-pneumo-thorax is suspected, and there is evidence of pus in one pleura, thoracentesis should be performed. We do not refer to phthisical cases. Some aver that if an empyema is spat up a certain mode of cure is attained. But I cordially agree with Marshall† who, after pointing out the danger of delay from emptying the lung of air and the greater compression it must undergo, says, "an immediate, a free opening is absolutely necessary whenever pneumothorax and empyema co-exist." Nor should the presence of purulent expectoration deter us, for, as already pointed out, it may be discharged by the lung, although no communication between the pleural cavity and the lung exists. The phenomenon was observed in the case of Thos Jones. (*case 2*, in the appendix), when on July 24, he was spitting up pus

* Dr. Alexander. *Lancet*, November 20th, 1875, p. 732.

† Marshall. *Ibid*, March 11th, 1882, p. 382.

in quantity. Thoracentesis was, however, performed, and he made a good recovery. A singular fact has been observed by Dr. Graves,* viz. :—that the fœtor of the expectoration, in a case of pyo-pneumo-thorax ceased on making an external opening; and in one case the temporary closure of the wound was followed by return of the fœtor in the bronchial secretion. Purulent expectoration, therefore, in a case of empyema should act as an incentive to operate, lest by delay, the case may pass into one of empyema, *plus* pneumo-thorax.

PARACENTESIS PERICARDII.

Our remarks on this subject will be short, because we have never had occasion to perform the operation.

Formerly the practice was to trepan the sternum, and Desault, Skiederup and Larrey have devised different modes of tapping the pericardial sac. The latest writer, Roberts, of Philadelphia, who has collected together all the recorded cases, and whose work deserves perusal, recommends that the operation be done in the 5th interspace, about $2\frac{1}{2}$ inches from the middle line of the sternum. A No. 1 trocar and canula, or a fine needle attached to an aspirator may be used for the purpose. The former is, however, quite as efficient as the latter, as the fluid will spurt through the instrument with considerable force as soon as the sac is penetrated.

Sibson, in his marvellous article on pericarditis in the 4th volume of Reynold's system of medicine, where the reader will find much valuable information respecting the operation, advises the use of an aspirator, and condemns incisions and irritating injections.

He recommends that "while the mass of the fluid is below the level of the lower edge of the fifth cartilage, that the fine trocar should be inserted into the distended pericardium at a point just above the upper edge of the sixth cartilage at the lowest part of its curve, more than

* Stokes, "Diseases of Chest" (New Sydenham Society's Edition) p. 542.

an inch within the mammary line; and that the instrument should penetrate gently inwards with a direction slightly downwards, so that it may advance into the collection of fluid, below the level of the heart. When, however, the heart is enlarged owing to the existence of valvular disease of some standing, the heart is sometimes to be felt beating in the fifth or even the sixth space at the time of the acme of the effusion, when the urgent distress and danger of the patient may demand paracentesis of the pericardium. Under such circumstances which can be readily discovered by ascertaining the position of the impulse—which should always be some distance above the point of penetration, for a thin layer of fluid interposes itself between the surface of the heart above its lower border and the front of the chest—another point than that just indicated in the fifth space must be chosen for the operation. The point should then be selected at the space between the left edge of the ensiform cartilage and the right border of the seventh cartilage in the epigastric region; or, if needful, owing to its margin being covered by the seventh costal cartilage, the ensiform cartilage at its left border may itself be perforated, first with the point of a bistoury, and then with a fine trocar.”

The distress and discomfort of the patient together with the strength of the pulse must be the indications for the operation; and it is a matter for comment that the pericardium will become immensely distended, until as it were, at any moment the effusion may by further increase overwhelm the heart, and yet no alarming symptoms occur. When a resident in hospital I have more than once kept a trocar and canula by the patient's bedside, ready for use in case dangerous symptoms should arise. But, whilst enjoining most strictly the recumbent posture and employing such drugs and other measures as the exigencies of the case seemed to require, I never found occasion to resort to paracentesis, nor did such a case of pericarditis ever terminate fatally. The dangerous symptoms, not the amount of fluid must be the indication for operation. However, the surgeon must bear in mind that the

operation has rescued patients from impending death, and it should never be withheld whenever dyspnœa comes on in a case of abundant effusion.

For fuller information on this subject consult—

Roberts. On Tapping the Pericardium. Philadelphia.

Sibson. Reynold's System of Medicine, where many references to cases and other authorities are given.

PUS AND BLOOD WITHIN THE PERICARDIUM.

No operative procedures are available in the latter case; and in the former no rule can be deduced, as purulent pericarditis is an indication of a bad state of health, and indeed does not often occur.

HYDATIDS.

We are not sure that the rupture of a hydatid cyst comes within meaning of the term intra-thoracic effusion, but we allude to it lest omission should be the worse fault. It sometimes occurs and is a very dangerous complication. We refer to a paper by Sir Josh. Fayrer in a *Lancet* of a recent year, as well as to other authorities. Antiseptic incision would appear the most hopeful procedure.

Case 21 in the appendix is one of hydatid of the lung, in which rare event, puncture, followed by aspiration, can only be entertained.

MEDIASTINAL EFFUSIONS.

Effusions into the mediastina will not detain us long, for two reasons. In the first place they are not frequent, and, in the second, the signs of them are obscure, and their diagnosis uncertain. The effusion may be poured out into the mediastinum primarily, or may find its way there after being formed in another part.

In the anterior mediastinum a purulent accumulation, or mediastinal abscess, may set in, and when discovered we are told that its management is easy. "As soon as

fluctuation is detected, it is well to explore with a fine aspirator needle attached to a small syringe. If pus be withdrawn the diagnosis is complete, and an effectual treatment becomes necessary. This should not consist in simple aspiration for the pus will rapidly collect again; aspiration followed by iodized or carbolic injections is also unsatisfactory. It is best to make a free incision and introduce a full-sized drainage tube, the operation being performed strictly antiseptically. The incision should be vertical and quite close to the margin of the sternum, in any intercostal space or other situation which will be most suitable. The internal mammary artery runs about half-an-inch or more from the margin of the sternum and as the abscess pushes the vessel aside outwards there is but little danger of wounding it. The incision is, of course, vertical, so as to be parallel with the line of the artery, and the abscess may be finally laid open by perforation with a probe-pointed director, and subsequent dilatation with the dressing forceps.”*

The present seems the most fitting occasion to insert the following notes, which, though lacking completeness, are of much interest, from the fact that a blow set up in the same patient, inflammation of the peritoneum, the pleura, and the pericardium; of the substance of one lung, and probably of the cellular tissue in the posterior mediastinum: and also from the favourable termination to which a large abscess in proximity to important organs was conducted.

The patient was a young man, 22 years of age, of previous good health. He was an enthusiastic football player, and ten days prior to the commencement of symptoms of illness, had received during a game of football a blow upon the shoulder, so severe that he could not raise the arm for three days afterwards. On the day before the onset of symptoms, the patient was exposed for half an hour to a draught through a broken window pane. The illness commenced with pains in the limbs and febrile disturbance, to which was soon

* Marshall. *Lancet*, Feb. 11, 1882, p. 299.

added abdominal pain. On October 7, 1878, the fourth day after the commencement of symptoms, he consulted his medical attendant, Mr. Scattergood, who kindly allows me to mention the case, when the symptoms of commencing peritonitis presented. Acute peritonitis then soon fully developed, and after a few days the tenderness of the lower part of the abdominal surface subsided somewhat, but was intensified in the epigastric region, especially near the upper limit. On the 12th day from the commencement of the illness the physical signs of pleurisy, pericarditis and inflammation of the lung around that part of the epigastrium which was the focus of the most intense local inflammatory signs, in addition to the peritonitis, were present; and ultimately, a pulsatile swelling formed in the epigastrium, just below the xiphoid cartilage. On November 12th, the 40th day of the illness, the swelling was explored with the aspirator needle, which was passed for a depth of two inches, when the point was felt to move freely in a cavity. During the aspiration, the pulsation so affected the needle that its free end was deflected for nearly half-an-inch with each pulsation. The result was that 28 ounces of horribly foetid pus were drawn out. The patient obtained immediate relief, the pulse falling from 120 per minute at the commencement of the aspiration to 100 at its close, and by methodical irrigation of the abscess sac with carbolic solution, at first twice daily and subsequently less often, through a gum-elastic catheter, the contraction and closure of the cavity were effected. The tube passed along a tortuous channel not less than two inches in length before reaching the abscess cavity, and was introduced for the last time at the end of April, 1879, or 30 weeks from the day the patient was first seen by Mr. Scattergood. Ever since the operation the patient has had very good health, and at the present time a small cicatrix near the ensiform cartilage is the only remnant of his severe and dangerous illness.

CHAPTER X.

THE OPERATIVE TREATMENT OF HÆMOTHORAX.

Blood may accumulate within the pleural cavity from the effects of disease or as a result of injury. Collections of blood have been found in the course of disease, from the bursting of an aneurism, rupture of the vessels of a phthisical cavity and other causes.

As, however, it is difficult to conceive that surgical skill or operative measures can be called into useful requisition in these cases, their treatment by such means will not be considered.

Effusions of blood originating in injury may—like fractures—be divided into two classes, viz.:—simple and compound. We designate those cases “simple” where there is no communication between the pleural cavity and the atmosphere, and denominate those “compound” where a penetrating wound proves such communication to exist.

Simple traumatic hæmothorax, or a collection of blood in the pleural cavity, the result of injury, which does not communicate with the external air, is the frequent accompaniment of fractures of the ribs: but a blow, a kick, a fall upon the chest, or violent squeeze, have given rise to this condition, without causing a fracture of the ribs.*

The most usual source of the effusion is laceration and wounding of the lung; and it is never possible to determine the extent of the internal mischief, nor predict at the outset the particular danger by which each patient will be threatened. In a limited number (six of 136 cases recorded by Bryant)† where the damage

* Taylor. *Principles and Practice of Medical Jurisprudence*, 1865, p. 538.

† Bryant. *Practice of Surgery*, 2nd edition, vol. ii., p. 35.

to the thoracic viscera is extensive, or where other injuries have been sustained, death from shock setting in immediately after the receipt of the injury terminates the case, and renders the surgeon's efforts futile. Simple hæmothorax from external violence without fracture of the ribs is often fatal from such cause. If the patient rally, the treatment next to be described will find appropriate application.

But let us turn from the profitless task of discussing how to save dying men, to the consideration of that class of cases in which simple hæmothorax can be traced to broken ribs, examples of which come within the observation and treatment of every practitioner. The following case will illustrate the subject:—

Wm. Irving, ætat 24, a healthy vigorous man, was, with four others, being drawn up the shaft of a deep quarry, and when they had ascended about twenty yards, a link of the chain snapped, and they fell to the bottom. A surgeon was quickly in attendance, and on the arrival of the men at the Huddersfield Infirmary, I found that Irving, besides numerous scalp wounds, had sustained an injury to the chest, the right side of which had been very neatly and accurately covered by strips of stout plaster. He was spitting blood freely, and on percussing the posterior aspect of the right chest-wall a dull sound prevailed from the lower limit to the angle of the scapula. He made a good recovery, and was sent to the Meltham Convalescent Home fourteen days after admission, no dulness then remaining. There was no lumbar ecchymosis.

This case, which is but the type of numberless others, reveals the fact that blood alone within the pleura can be completely absorbed, and confirms—if confirmation be necessary—the results obtained by Trousseau in his experiments upon horses. Trousseau produced an artificial hæmothorax, either by opening an intercostal artery or by conveying blood direct from the jugular vein to the cavity of the pleura; and in nearly all the cases no traces of the blood, or only a little sanguineous serosity could be found at the end of 48 hours. In no

case was there any sign of inflammation of the lining membrane of the pleura.*

The knowledge of these facts demonstrates what daily experience proves, that direct surgical interference to remove blood from the closed pleural cavity must not, except under special circumstances, be thought of.

A practitioner's success will rest more upon his acquaintance with minor matters and attention to small details, than upon his ability to diagnose and treat obscure nervous complaints, or his desire for daring achievements with the knife. And among the operations very inaptly termed "minor"—for their adequate performance is of the greatest import—there are few which will reflect more credit on the surgeon's art, or call forth more spontaneous expressions of gratitude from the patient, than that of limiting the movements of an injured chest-wall. It should be adopted in all such cases as a matter of routine, and as the simple traumatic effusion of blood comes within its scope, an allusion to it must be made in an account of the operative treatment of intra-thoracic effusion. In putting it into practice its object, viz., that of impeding the respiratory movements of the injured side, should be borne in mind, and for this purpose strips of stout plaster, such as the pharmacopœial Emp. Roboran's, Guy's Strapping, spread on Holland, or the hospital strapping sold by Leslie, or St. Dalmas of Leicester, one inch and a half broad, are firmly applied over the surface of the injured side, commencing below. Each strip should be long enough to cover the injured, and pass behind and in front, two inches upon the sound side. Otherwise—and as often occurs in practice—no limitation of the movements will be secured. And by commencing to apply the plaster from below the expansion of the lung is more effectually overcome; for, any attempt to bind down the upper ribs before those below them have been confined, would result in failure. If the strapping do not stick unless

* Trousseau. Clinical Medicine. vol. 3, p. 295.

warmed, care should be taken that the adhesive layer be not liquefied by excessive heat; and both the extremities should be held in position until they have become permanently fixed. The use of a broad band of strapping enveloping the whole chest, or the application of a strong cotton or flannel roller, will answer well in some cases; but their employment from the constriction of the whole chest they necessitate, cannot be so universal as the use of the method just recommended. They are especially unsuited for elderly people, and, moreover, if the ends of each strip of plaster, applied as recommended, overlap at least two inches, each expansion of the sound side will increase the tension of the plaster case, and further limit the movements of the injured one. In applying the strapping or bandage the amount of pressure to be used in each case must be determined by the feelings of the patient. It may safely be applied as firmly as the patient can bear; and it will generally be found that within reasonable limits, the relief afforded is in proportion to the pressure used; although in certain cases, as when the end of a broken rib is depressed, the application of any constricting force cannot be borne, and must not be used.

Absolute rest and spare diet are the necessary auxiliaries in the treatment of simple hæmothorax; and it will often be found that the semi-recumbent position is the most comfortable. Indeed, in the case of patients above 50 years of age, or prematurely old, it should be insisted on; and this, conjoined with the administration of antimonials in small doses, salines and opium, the details of which do not concern us, makes the prognosis usually favourable. In a person of average health, and not above middle age, a moderate effusion of blood within the chest in a case of fractured ribs may be considered rather an advantage than otherwise. By its size it mechanically interferes with the expansion of the lung, inducing shallow breathing and consequent rest to the fractured part; its presence in the pleura is not likely to set up inflammation; whereas the anti-phlogistic virtues of a sudden loss of blood lessen the

latter risk. We know that blood is rapidly absorbed from the pleura, and we may presume that by its bulk and coagulation it acts as a plug to the orifice from which it issued, and prevents the effusion from becoming dangerously excessive.

Before passing to the consideration of cases of compound effusion, it will be convenient to allude to a class—happily rare—in which the quantity of the effused blood is considerable, and interfering mechanically with the expansion of the lung, threatens the patient's life by asphyxia. As may be conceived, here the question of operation for the removal of the blood is a delicate one; for although the effects of a mass of blood within the pleura suddenly displacing the viscera may be very dangerous, on the other hand, the compressing force it exerts must be considerable, and must control the flow of blood from the wounded structure; and by removing this pressure, the salutary coagulation around the bleeding point may be prevented, and a recurrence of hæmorrhage induced. I have already referred to the capability of rapidly absorbing blood which the healthy pleura possesses, and the prudent surgeon will not disturb effused blood, except in cases of pressing emergency. In a short time coagulation of the blood will take place, a process which—as it occurs outside the pleura—is always followed by contraction of the clot and the separation of the serous liquid. And there is no reason to suppose that the phenomena of coagulation will be materially interfered with in the pleural cavity, nor if the serous portion be squeezed from the clot, but that it will be rapidly absorbed by the lining membrane. A very considerable diminution of the foreign body in the pleura will thus be secured, increased breathing power gained, and the lung will return to its normal proportions as rapidly as the lessening bulk will allow.

But should, unfortunately, the immediate necessities of the case, as evidenced by symptoms shortly to be described, show that danger by suffocation is urgent, the removal of the blood must be attempted. Trousseau, in the experiments already cited, found the

blood introduced into the pleural cavity completely coagulated in less than two minutes, and, in some of the cases, before the heart ceased to beat.* But it must be within the recollection of my readers that they have seen in the *post-mortem* room effused blood, which was almost entirely fluid. Taylor† says, “With regard to these fatal effusions within the chest walls, as well as in the other great cavities, it may be proper to mention that from whatsoever vessel or vessels the blood may have issued, it is not commonly found coagulated to any extent; the greater part of it generally preserves the liquid state; and it is rare that so much as one-half of the quantity effused is met with in the form of coagulum.” And in a case he records (that where a child was run over, and died from rupture of the heart) a pint of blood was found; whilst, in another, the pericardium was distended with dark fluid blood. The experiments of Trousseau were performed upon horses, and this fact may explain the discrepancies between them and the observations of Taylor.

It would appear also of importance to note, that after death by asphyxia the blood is often found unusually fluid. Casper examined forty-three cases of fatal asphyxia, and the blood was found uncoagulated in thirty-eight, although a considerable time had elapsed since death.‡ He attaches considerable importance to this condition as a sign of death by drowning. Dr. John Davey and Mr. Gulliver also report that they have found the blood permanently uncoagulable in cases of death from drowning, hanging, suffocation from the fumes of burning charcoal, and extravasation of blood into the pulmonary air-cells.||

When surgical interference is called for asphyxia is the impending danger, and we may presume therefore

* Trousseau. Clinical Medicine, vol. 3, p. 295.

† Principles and Practice of Medical Jurisprudence, p. 542.

‡ Forensic Medicine, vol. 2, p. 241.

|| Richardson, On the Coagulation of the Blood, p. 34.

that a portion of the blood will partake of the fluid quality described by Casper and Gulliver, and that there will be reasonable hope of removing it by the aspirator. Having carefully defined the dull area it will be requisite to insert a broad needle midway between its upper and lower limits, and when the needle has been sufficiently introduced its point should be directed upwards, as the more liquid blood will remain uppermost, and if coagulation, with the separation of serum have occurred, the serous liquid will likewise ascend. If the blood cannot be removed by the aspirator, a free incision four inches long, made in the same manner as the smaller wound recommended in the section on empyema, to allow the introduction of the finger, a long curved probe, or a scoop to break up the clot, would be required. Strict antiseptic precautions must, if possible, be adopted. If the blood have lain some time in the pleura, it will be impossible to remove it by the aspirator, and except in the case of renewed bleeding it seems difficult to imagine a case requiring it. The incision must then be made: as it must also in a case where hectic and fever announce decomposition of the contained blood with the formation of empyema. The injection of fluid to break up the clot is mentioned only to remark upon its dangers and uselessness. In conclusion, the indications for any operative interference in simple hæmothorax must be sure and decided: and it is necessary that the dyspnœa and cyanosis be not mistaken for that which may be caused by a congested or inflamed lung; and in all cases a careful thorough physical examination should be made.

I shall reserve my remarks on the use of bleeding as an operative remedy in hæmothorax for discussion when I consider compound hæmothorax.

Simple hæmothorax, the result of injury, may occur from a rupture of the heart, and in such a case no operative treatment is of avail; or from erosion of the intercostal artery in caries of the ribs, in which case the urgency of symptoms and amount of bleeding must guide the surgeon in any attempt to remove the blood, or check the bleeding by ligature or compression.

COMPOUND HÆMOTHORAX.

The cases of effused blood in the pleura, which I denominate "compound" are in civil practice occasionally met with, and our knowledge of the best methods of treating them is obtained from the records of military surgery. In the field of battle they form one of the most fatal varieties of gun-shot wounds, and from the target which the expansive chest affords to the enemy, one of the most frequent. Most of the cases die before aid can be brought to them, whilst many die after removal to the Field Hospital. Thus, out of 603 men who returned wounded from the Indian mutiny of 1858, only 19 of that number had received wounds of the chest.*

But our subject is the treatment of one of the results rather than that of the wounds themselves, viz.:—the effusion of the blood arising from them. It must be stated at the outset that compound hæmothorax is a more dangerous condition than the simple variety† which bears out the analogy I have drawn between fractures and hæmothorax, by dividing the latter into simple and compound. The chest wall may be wounded, hæmothorax occur, and yet no communication between the effused blood and the atmosphere be present; and in

* Williamson. "Military Surgery" London, 1863, p. 237.
Consult also Liddell. Traumatic Hæmorrhage, New York, 1870.

† M. Chenu, p. 187.

In French Army in Crimea—Mortality of non-penetrating wounds, 12 per cent.

Mortality of penetrating wounds, 91·6 per cent.

Matthew, vol. II., p. 313.

In British Army in Crimea—Mortality of all chest wounds, 26·6 per cent.

Mortality of lung wounds, 79·26 per cent.

Barnes and Otis.

Medical and Surgical History of War of Rebellion, p. 599,
of 8715 cases of penetrating wounds of chest. 5260 or
62·6 per cent. fatal. Of 20607 cases of wounds of
chest, average mortality was 27·5.

MacCormac had mortality of 54·8 per cent. after Sedan.

every doubtful case it is the surgeon's duty to refrain from undue exploration of the wound, lest, by officious probing, or over-anxious fingering, he convert a simple into a compound hæmothorax. If there is reason to believe that a foreign body has lodged, discrete prudence must temper his search for it, and the requirements of each case be determined on its merits. Although, formerly, various devices, more remarkable for ingenuity than a consideration of the patient's life, were practised and universally recommended, the general opinion at the present time is, that in doubtful cases, the wound should not be meddled with.* As in the case of simple hæmothorax, it is from the lung that the blood most frequently comes, but its source may be in any of the large vessels at the root of the neck, *e. g.*, the subclavian artery, the heart, the coronary, the intercostal or internal mammary arteries. It will, therefore, be easily understood that penetrating wounds at the upper part of the chest are more fatal than in the inferior region, and that unless prompt aid be rendered to the patient, he will in many instances succumb; while in others, the most skilful surgeon cannot ward off the fatal issue, although he be present when the injury is inflicted. Should the subclavian artery be wounded, its deligation must be at once accomplished. A description of this important operation would, however, be out of place in this monograph.† Compression is to be used until the operation can be commenced.

Excluding cases of injury to the large vessels of the neck, the severity and extent of a compound hæmothorax rest upon the amount of mischief actually perpetrated within the chest. Gunshot wounds, stabs (of which the tragedy in Phoenix Park, Dublin, is a

* For apposite remarks on this head, consult Poland "On injuries of the chest." Holmes System of Surgery.

† Billroth tied the subclavian artery three times, and assisted at two other ligations for bleeding from main trunk during Franco-German War.

See Billroth. Chirurgische Briefe, U.S., W.S., 122.

melancholy example) bayonet wounds, and the penetration of the chest by blunt weapons or bodies, have caused this condition.

After the last-named accident some remarkable instances of recovery are on record.*

Hæmothorax will not be the prominent feature of the case, as the blunt instrument does not as a rule penetrate the lung.

Hæmothorax from punctured or incised wounds.

If a sharp edged weapon penetrate the chest and wound the heart, the aorta or any of the large vessels the surgeon can do little; and on the other hand if the lung alone be punctured, and the stabbing instrument be withdrawn without leaving any foreign body in the thorax, his operative measures will seldom be needed to subdue or remove hæmothorax. It has been suggested as a means of determining whether a wound of the chest be penetrating to carefully examine the stains on the weapon, which will correspond to the depth it has been inserted, and this should always be done. If some attempt has been made to cut the lung after the entrance of the weapon, the production of hæmothorax is much more probable than from a simple punctured wound, the sides of which will coalesce as the weapon is withdrawn, and at the same time check bleeding and prevent the access of air. The achievements of subcutaneous surgery, and the harmlessness of puncture of the lung, after the use of the exploring needle for diagnostic purposes, show that such an event must happen. Cases of penetrating punctured wound of the lung must be treated, therefore, as cases of simple hæmothorax careful physical examination of the chest being made in all cases. The wound itself should be closed with a pad dipped in styptic colloid or collodion if not more than an inch in length; but if extension of

* Maraen. "An account of a case of recovery after the shaft of a chaise had been forced through the thorax." London, 1824.
Dr. A. C. Garrett. Boston *Medical and Surgical Journal*, for 1857. Vol. 57, p. 488.

the wound show that cutting or laceration has been caused, it will be better to apply antiseptic dressings. Sutures must be inserted to draw the edges of the skin together where necessary. The case may then be regarded as one of simple hæmothorax, although a jealous look out for inflammation of the lung or pleura must be kept up.

Hæmothorax from gun-shot wounds.

Compound hæmothorax, arising from gun-shot wounds, will usually be found to sustain the cognomen "compound," as fractures of the ribs, the lodgment of foreign bodies, such as bullets or portions of shot and shell, which frequently carry before them fragments of clothing or comminuted bone, or even buttons and metallic substances which the wounded man may have about his person, complicate the prognosis; while pleurisy, pneumonia, hydro-thorax, pneumothorax, empyema, necrosis of the ribs and pyæmia are among the immediate sequela; and a deformed thorax one of the remote.

As in simple hæmothorax, the quantity of effused blood may be sufficient to compress the lung, and produce asphyxia if it cannot escape by the parietal wound, or the patient may die from loss of blood should the aperture permit the blood to flow out. In cases, however, where the danger from asphyxia is not apparent, the three cardinal surgical principles of wound treatment must be obeyed with certain restrictions—

Check the hæmorrhage:

Remove foreign bodies:

Put the injured part at rest.

To check hæmorrhage the homœopathic maxim—*similia similibus curantur*—was formerly respected; and it was usual to endeavour to arrest bleeding in one part of the body, by counter-depletion in another. In cases of moderate effusion, however, venesection will not be demanded. If the bleeding come from the intercostal or internal mammary artery, an endeavour should be made to secure the bleeding point, and if

this be impossible, the vessel may be cut completely across, so that the divided ends may be able to retract within the sheath; or the device known as "Desault's Purse" may be adopted to compress the bleeding vessel.*

Concerning the removal of foreign bodies no precise rules for guidance in difficult cases can be deduced. If the body be within reach and palpably present it must be removed with forceps, enlargement of the wound if necessary being permissible; but we must remember that undue probing of the wound and prolonged examination increase the risk of subsequent inflammation. "There is a wide interval between such meddling and judicious use of the forceps in cases in which there are just grounds for suspecting the presence of a foreign body, and the sagacious practitioner will neither discard the probe absolutely nor use it habitually. It is almost needless to repeat that all good surgeons agree that the finger is the best probe whenever available."† But, as may be surmised, the difficulty is to properly interpret this trite and incontestible aphorism of the Surgeon-General of the United States Army.

In order to secure as much rest as possible for the wound, the injured side should be enveloped by strapping, as described at page 215, or the plaster of Paris bandage, recommended by Pirogoff, and used

* For three cases of fatal hæmorrhage from intercostal artery, verified by Autopsy, see Medical and Surgical History of the War of the Rebellion, vol. 1, p. 526.

See also Longmore, Gunshot Wounds, Holmes' System of Surgery. Watson, on Homicide, p. 101.

† Medical & Surgical History of the War of the Rebellion, p. 593. See also Pirogoff (Grundzüge der allgemeinen Kriegschirurgie. Leipzig, 1864, p. 534.)

Dupuytren (Leçons orales de clinique chirurgicale, tome 6, p. 382.)

Legouest (Traité de Chirurgie d'Armée, p. 357.)

Ericksen (Science and Art of Surgery, vol. 1, sixth edit., p. 489.)

with success by Russian and German Surgeons, may be substituted.* If the wound be large, it may be partially closed, and the edges brought together, for the greater part of their length, by fine wire sutures where possible. When a small wound exists, fine sutures having been inserted, a pad of lint soaked with collodion may be laid over it and there secured; and the operation known as "hermetically sealing" the wound thus performed.† If this be not done, it may be dressed in a simple manner, according to the liking and custom of the operator. If blood be issuing from the wound, the patient should be turned upon the injured side, that it may the more readily escape. I have not had opportunities of treating any cases by antiseptics; but I conceive that there is here a fruitful field for the further success of this mode of surgical dressing, and from the success which has attended its practice in cases of empyema, I cannot but think that results, more satisfactory than any hitherto recorded in the treatment of compound hæmothorax, would be secured. In the case of large wounds I should recommend the introduction of a drainage tube. In all cases anodynes must be given to subdue coughing, which might tear open the wound and drag out the sutures. Opium is the most convenient and reliable drug, and its effects must be most carefully watched, as

* Pirogoff. *Opus Cit*, p. 537.

† Consult

Medical and Surgical History of the War of the Rebellion, vol. 1, p. 497, *et seq.*

Hennen. *Principles of Military Surgery*, third edit., 1826, p. 378.

Howard B. (The re-introducer of hermetically sealing penetrating chest wounds.) *American Medical Times*, vol. 7, p. 156. Oct. 1863.

Longmore. *Lancet*, vol. 1, 1864, p. 6.

Chisholm. *Confederate States Medical and Surgical Journal*, Sept., 1864, p. 138.

after loss of blood there is more susceptibility to its action.

We must ever bear in mind the observations of Trousseau of the innocuous properties of blood within the pleura, and hope, by prompt closure of the wound, or the immediate application of antiseptic dressings, that we have converted a compound into a simple hæmothorax.

If the patient survive the injury three days, the occurrence of consecutive inflammation must be expected. Careful, but gentle, physical examination must not be omitted, as hydrothorax and empyema run their course very rapidly after a gunshot wound in the chest; and if relief be not promptly afforded, the mechanical effects of the rapid effusion may be fatal. The case must then be treated as one of pleuritic effusion or empyema.

In all cases, too early return to active life should be avoided. There is always a danger of secondary hæmorrhage, and patients have been lost from this cause when they were apparently progressing favourably. If, after closing the wound, hæmorrhage continue, and blood accumulate within the chest, alarming symptoms will come on. "Dyspnœa may become excessive; the breathing is frequent and laboured; there is urgent anxiety, and oppression and agitation; the patient seeks to sit upright (orthopnœa), or can tolerate only a dorsal decubitus; or can rest only on the wounded side; or throws himself from one posture to another—drawing up the thighs, elevating the head and shoulders; in short, fighting for breath. He has a sense of great constriction and weight at the chest. There is dulness on percussion, and the respiratory murmur is absent on the wounded side to the level of the effusion; the intercostal spaces are protuberant, the ribs are separated and raised, the hypochondriac region is prominent, the injured side moves but little in respiration. These physical signs are modified when air is present in the cavity; when there is tympanitic resonance above, and below absolute dulness. The undulations of the fluid are felt by the patient in sudden

movements. The blood gushes out of the wound in coughing or violent expiration. Superadded to these signs are those of copious hæmorrhage; the pulse becomes frequent small, irregular, the face is pallid, the lips livid, the extremities cold; vertigo, singing in the ears, and other premonitions of syncope supervene. In the presence of this formidable array of symptoms, the surgeon's first thought is to stanch the bleeding."* It is not my duty to discuss all the plans adopted for this laudable object, and while referring to sources of information on the point† will observe that venesection has been discarded, and surgeons, influenced greatly by the results of the American Civil War, place reliance upon the local application of ice, closure of the wound, warm friction and sinapisms to the extremities. If the bleeding cease the case must be treated as a simple hæmothorax; but on the contrary, should increasing dulness of the chest, and aggravation of the symptoms continue, the wound must be opened up, and if necessary, enlarged, in order that the effused blood may be let out. "If the escape of blood does not relieve the patient, but only weakens him, then the wound must be closed again, the revulsive applications

* This graphic description is from the *Med. and Surg. Hist. of the War of the Rebellion*, vol. I., pp. 624-5

† John Hunter. *Works by Palmer*, vol. III.

Guthrie. *Commentaries*.

Hennen. *Principles of Military Surgery*, London, 1829.

Macleod. *Notes on the Surgery of the War in the Crimea*, 1858, p. 237.

Lawson G. *On Gun-shot Wounds of the Thorax*.

Blenkins. *Gun-shot Wounds*. In *Cooper's Dictionary of Practical Surgery*.

A manual of *Military Surgery for the use of the Confederate States Army*, p. 97,

Neudorfer. *Handbuch der Kriegschirurgie*, Zweite-hälfte, S. 605, 1867.

Longmore. *Holmes' System of Surgery*, art. *Gun-shot Wounds*.

Poland. *Holmes' System of Surgery*, *Injuries of the Chest*.

Stromeyer. *Experiences of Gun-shot Wounds*, p. 42.

Legouest. *Traité de Chirurgie de Armée*, p. 353.

Larrey. *Clinique Chirurgie*, Tome IV., p. 101.

to the general surface and the refrigerant local applications resumed ; the patient laid on his injured side, his head and shoulders raised, his chest bandaged if he can tolerate it, and thus persevering, opening and closing the wound, hoping to gain time, and to stave off the most pressing danger.”*

Although such is now considered the orthodox treatment, it is possible, nay even probable, that the rejection of venesection from the surgeon's armamentarium may have been too complete. It is allowed that the patient's life is threatened by asphyxia, rather than endangered by loss of blood and syncope. Death by drowning occurs from asphyxia ; and recovery after the immersion, besides depending upon the duration the person has been under water, will be influenced by the activity of the general circulation. If the circulation be rapid and the pulse full, the respiratory efforts will be proportionately violent and strong ; the air within the chest will quickly be vitiated, and life will soon become impossible. But, should the state of the circulation be quiet, the strength of the heart's beats feeble, and the quantity of blood driven through the system small, the need for respiration will be diminished, and death will not ensue so rapidly. Indeed, cases of complete prolonged immersion followed by recovery, can only be satisfactorily explained on the supposition that the person fainted, and was in a state of syncope at the moment of falling into the water. And on investigation such is generally found to have been the case.†

It would seem, therefore, reasonable to suppose that if, in cases of severe and accumulating hæmorrhage within the chest, a condition of syncope could be induced, that the diminished quantity of blood flowing through the lungs would, even in their crippled state, find sufficient opportunity for oxygenation, and for those changes which are essential to life. This suggestion applies more extensively to cases that occur in

* Med. and Surg. History, War of Rebellion, p, 652.

† Medico-Chirurgical Trans., 1864, vol. 44, p. 149.

civil life than to those met with on the field of battle ; as the patients will be more robust and better able to bear depletion than the young recruit, or the veteran soldier who has passed through the fatigues and excitement of a battle, or experienced the hardships of a cruel campaign. The object of the bleeding being, not to draw off blood in quantity, but to make a sudden impression on the circulation, the blood should be drawn in a full stream, the patient being placed in an erect or sitting posture. As small a quantity of blood as possible should be drawn in order to produce the desired effect. And conjoined with this treatment—to which, as an operation, I have been compelled to allude—the measures previously mentioned may be of service and can always be adopted. Of bleeding Longmore says :—*

“ Where hæmorrhage is manifestly going on internally it may be practised with a view of draining blood from the system, and more speedily inducing faintness, to give an opportunity to the pulmonic vessels to become closed ; but, even, when thus applied, the general state of the patient will not be unconsidered by a judicious surgeon, nor caution neglected lest the venesection cause him to sink more rapidly from the additional shock to the system and destruction of restorative force.”

Compound hæmothorax may result from erosion of the intercostal artery during caries of the rib. Its treatment will be the same as for empyema ; the hæmorrhage having been previously checked. Compound hæmothorax may also result during operations upon the chest wall, and the reader will find in the section upon the operation for empyema, how to avoid its production or minimise its dangers when present. (*See page 102.*)

THE EFFUSION OF GASTRIC AND INTESTINAL CONTENTS.

These rare accidents are the result of excessive vio-

* Holmes' System of Surgery. Art : Gun Shot Wounds.

lence, which, while rupturing the walls of the bowel or stomach, forces them and their contents through the diaphragm into the pleura; or the contents of the stomach may escape from that viscus by the ultimate perforation of a Gastric ulcer, whose progress has been lengthened and collapse averted, by the formation of adhesions with the diaphragm; and, lastly, the rupture of a diaphragmatic hernia may result in the effusion of its contents within the chest.

In those cases the result of injury the lesion is never limited to simple perforation of the intestine or diaphragm, but will embrace displacement of organs, or disorganization of viscera which cannot but prove fatal. Surgical aid is useless.

The establishment of communication between the pleural cavity and the stomach through the channel left by a perforating gastric ulcer, is an occurrence of greater rarity than the last named accident. The event is usually preceded by the formation of small abscesses around or within the adhesions of the parts, and these abscesses are the real cause of the perforation. Habershon has related cases where this event has occurred (*Diseases of the abdomen*, pp. 171, 185, 193, 195 and 198. See also the same author, *Pathological Society's Transactions*, 1847-8, p. 252. *Observations on the alimentary canal*, p. 82) though Brinton, in his monograph on ulcer of the stomach makes no direct allusion to it. One of my teachers in his lectures used to relate the case of a young lady, the subject of gastric ulcer; in whom, perforation of the diaphragm into the pleura took place, and proved fatal by inducing "most horrible pleurisy." The treatment of these cases, from their fortunate rarity, has never been laid down with precision, and as regards operative treatment, incision of the chest as advised for empyema is the only hopeful procedure. The incision must not be less than five inches in length, or longer, if the cavity of the pleura cannot by that means be thoroughly emptied and washed out with some antiseptic solution. Rectal alimentation, might then, by keeping the stomach empty, permit the hole in the diaphragm to close, and

if the aperture be within reach, the application of some stimulating astringent like Sulphate of Copper, Lapis Divinis, or even Nitrate of Silver, in the solid state, might accelerate that desirable event.

Should the contents of a diaphragmatic hernia be suddenly expelled into the cavity of the pleura, the treatment suggested for perforating ulcer might be tried, but, we think, the prognosis would not be ameliorated by such procedure, as the release of tension in the gut would allow it to be dragged into the abdomen, where renewed effusion, with consecutive peritonitis would result.

It is unnecessary to enter into any details in the diagnosis of this class of intra-thoracic effusion. It is one of the rarest forms, and few practitioners have seen a single case, and from practice afforded by the more frequent varieties of thoracic disease, they will be enabled to recognise the accident. As regards the results of treatment it must be remembered that the surgeon has to cope with an abdominal affection, suddenly complicated by the addition of grave thoracic mischief, and has therefore to treat two diseases, a task which, in the class of cases we are considering, has never yielded a favourable result.

A case is recorded* of pneumothorax supposed to be due to perforation of a gastric ulcer and ending in recovery. Respecting it we would remark, that the recovery of the patient we do not doubt, but should be disposed to question the correctness of the diagnosis.

STATISTICS.

It is usually expected that a writer will collect for the information of his readers, as well as to advance the cause he advocates, statistics of any operation he may recommend or discountenance; and the aggregate results, being grouped and classified, may then be compared with similarly arranged materials respecting other operations. At the commencement of my essay

* *Lancet*, Feb. 4, 1874, p. 179.

I entered upon such a task with earnestness, hoping that I might arrive at a true estimate of the operations for Intra-thoracic Effusion by a compilation of cases from the published records and works. I was, however, soon convinced that labour thus spent was mis-directed, and would yield data and results unreliable and therefore useless. For I found that the term empyema, was applied by different writers to two totally and essentially distinct affections, viz., fibrino-serous and purulent collections; and that in the accounts of the operation adopted, "paracentesis," according to one writer meant tapping the chest by the trocar, but another understood by it aspiration of the chest, whilst a third applied it to the major operation of incision. Doubt and uncertainty were therefore raised when dealing with those cases where the nature of the operation was not stated precisely. Indeed, I must have either rejected altogether the published cases, a course which I have preferred to adopt, or have selected from them those cases the records of which were free from ambiguity and uncertainty. But, apart from the fact that such a course was liable to leave out of consideration a large number of cases which would materially affect the issue, and would also have reduced the numbers available for comparison to insignificant proportions, conclusions drawn from even that number are open to fallacy. In the first place the operation is performed by some after only a short trial of drugs, whilst others—like their *confreres*, a very numerous class—do not have recourse to paracentesis until they have well nigh exhausted every expedient; whilst the "go-between practitioners," who follow a practice intermediate between that of the enthusiastic operator and the patient therapist, and whose results would be the most valuable, form undoubtedly the smallest class. If we adduced the results of those who practice the operation at an early stage of the disease, it would be open for anyone to reply that, whilst many of the cases had made good recoveries, they would have done so equally well had no operation been performed; or on the other hand, the results of an opposite practice might

with considerable reason be rejected, because earlier recourse to the operation, if it did not save life, might have shortened the duration of the illnesses and produced more satisfactory and permanent cures. For example, M. Morand, a French Military Surgeon, thus speaks of the operation.* “As to the supposed innocuity of repeated paracentesis it is to be observed that in the six cases in which the discharge became purulent such repetitions had occurred in four. Among the accidents occurring in the 32 cases, these consisted of syncope in 4, of suffocative paroxysm in 11, and of albuminous expectoration in 2. The general conclusions at which M. Morand arrives are that in consequence of the repeated re-accumulation of fluid paracentesis is a useless operation, while owing to the occurrence of the more or less menacing accidents alluded to above (altogether 17 in number) and of the purulent transformation of the fluid occurring in six cases, it must be regarded as a dangerous one. Not that it should be altogether renounced, but confined to those comparatively rare cases in which the life of the patient is menaced by the abundance or suddenness of the effusion—as announced by dyspnœa, cyanosis, great and extreme dulness, the abolition of thoracic vibration, the displacement of the heart, and especially, by the general condition of exhaustion of the patient. He would say that we should never operate in serous pleurisy, with M. Roger, when the effusion is moderate, and rarely when this is great, doing so exclusively when the urgent signs just enumerated are present.” M. Morand cites as an argument that the average stay in hospital, and mortality, of 31 cases where paracentesis was performed was 72·67 days and 16·12 per cent. respectively, as compared with an average of 40·60 days and 5·50 per cent. in those where no operative measures were taken. But such statistics coming from one who does not perform the operation until the cases become desperate, when its effects are least beneficial and lasting, include

* *Medical Times and Gazette.* May 4th, 1878, p. 484.

in the one class cases which would recover without any operation, and which are totally unfitted for comparison with the grave cases in the other class for which the operation is reserved, and which by earlier, but judicious, operation might have been kept from the last-named category.

When also, the complications and duration of the disease, the conditions of life, the constitution, the surroundings, mode of life, and age of each patient, have to be added to the value which each particular surgeon attaches to the operation, the task of compiling statistics, even if otherwise practicable, is a stupendous and, alas, an almost thankless one, and I find that someone besides myself has attempted and given up the task as impossible.*

Drs. Wilson Fox and Goodhart have collected and tabulated a considerable number of cases, and we refer the reader to their essays, both of which deserve careful consideration.† But we believe it is impossible to deduce the treatment of intra-thoracic effusion, operative or otherwise, from statistics. Each case must be treated upon its merits, must be watched with the care it seems to demand, and the advisability of any operation seriously considered before it is undertaken. It would be waste of time to demonstrate that pleuritic effusion may prove fatal, and although at the present day we do not meet so large a mortality as that which led Trousseau to his earnest advocacy and fearless performance of paracentesis, deaths occur sufficiently often to rouse anxious solicitude when our patients pass across the boundary which separates a state of comparative safety from one of comparative danger.

* W. W. Moxhay. *Lancet*, Jan. 15, 1881, p. 99.

† Wilson Fox. *British Medical Journal*, Nov. 24, 1877, p. 722.
Dec. 1, 1877, p. 752.

Goodhart. *Ibid*, Dec. 8, 1877, p. 795.

THE APPENDIX.

THE APPENDIX.

The collection of cases which I present as the practical portion of my essay, is chiefly made up of extracts made, *verbatim et literatim*, from the clinical records of Leeds General Infirmary, by the courtesy of Drs. A. G. Barrs and J. F. Silk, the late and present house-physicians; and which, by kind permission of Drs. Clifford Allbutt and Eddison, under whose care the patients were, I am enabled to publish. The Infirmary contains 300 beds, of which about 70 are allotted to the medical cases. The notes are those taken by the house-physician and his assistants, the other resident medical officers. It was my good fortune to hold the office of senior assistant resident medical officer, and many of the notes are taken by myself. It may seem that I have in this place written them out too fully, but, at the risk of including unimportant details, I have preferred to present them in the reporter's own words, that the reader may form his own judgment of their meaning.

Contradictions or discrepancies in the notes arise from the circumstance that, neither the house-physician nor his assistants exclusively report each case, and when no date is prefixed the notes were taken on the day the patient entered the hospital. It must be understood that the ribs are counted from above, and it is to be regretted that—owing to the multifarious duties of hospital routine—the accounts of the progress of the patient prior to discharge are in many instances omitted. The notes were taken with due care, but negative facts are as a rule not mentioned. "Remarks" at the end of the notes are by the house-physician. The reports

were not selected, but taken consecutively from the records to which I had access. Cases 1 to 35 inclusive are from the note book of the Leeds Infirmary, the remainder are those *of which I have preserved notes* during and since my house-surgeoncy at the Huddersfield Infirmary.

THE EMPYEMATA.

Cases I—II inclusive and case 22.

We think the results of the cases here recorded will bear comparison with any that have been published. In all the treatment I have described and recommended was carried out. Of both fatal cases it may be said, that they would have inevitably succumbed if no operation had been performed, and the majority of the remainder would likewise have taken a retrograde course, unless the beneficent aid of thoracentesis had been invoked. Case 11, that of a delicate "strumous" lad, whom I recollect well, makes the average duration of the cases after operation longer than if his case were left out of consideration. It would be unfair concealment on our part if we omitted to state that we have seen cases of empyema ending in permanent thoracic fistula, after thoracentesis; but, not having preserved notes, we do not include them in the appendix. We can call to mind two cases, both being of longstanding prior to the operation; one of them was the case mentioned at page 30, air passing into a fibrino-serous effusion—an empyema being the result.

The operation practised in these cases is that described by the author, which he learnt whilst a resident at the Leeds General Infirmary, and where he frequently saw it successfully performed by the then house-surgeon, Mr. Walter Hy. Brown.

Since this essay was written, Dr. Eddison, physician to the Leeds Infirmary, has collected together forty cases of empyema, which have been treated under the care of the physicians of that institution. The results were presented to the members of the British Medical Association, at the annual meeting recently held in

Liverpool, and will, it is hoped, be published in *The Journal* in due course.

RESULTS.

Mortality.—2 in 12, or 16·6 per cent.

Treatment.—Antiseptic incision in all cases.

Average stay in hospital.—54 $\frac{1}{4}$ days (or excluding fatal cases, Nos. 10 and 22) 63 $\frac{9}{10}$ days.

Average duration of treatment after incision.—43 days or (excluding fatal cases) 51 days.

Spat up pus before operation.—Cases 2 and 7.

Drainage tube slipped into chest.—Case 3.

Carboluria.—Cases 6, 7 and 8.

Tapped before incision.—Case 11. Tapped three times.

On first occasion “12 fluid ounces of serum.”

On second, 17 days after, “42 $\frac{1}{2}$ fluid ounces of slightly turbid serum, containing pus cells;” 42 days after last tapping, “21 ounces of turbo-purulent fluid.”

Case 22. Sero-purulent fluid withdrawn.

Complications of Empyema.—Advanced phthisis with pulmonary fistula. Case 10, fatal.

Pneumothorax.—Case 22, fatal. Probably phthisis.

Duration of illness before pus was removed from chest, with age and sex of each patient, also duration of case after operation.—

Case.	Sex.	Age.	Duration of Illness.	Duration after Operation.
1 ...	M. ...	31 ...	3 mos. ...	56 days.
2 ...	M. ...	40 ...	10 weeks ...	53 „
3 ...	M. ...	8 ...	6 „ ...	49 „
4 ...	F. ...	5 ...	14 „ ...	40 „
5 ...	F. ...	4 $\frac{1}{2}$...	11 „ ...	31 „
6 ...	M. ...	20 ...	7 „ ...	41 „
7 ...	F. ...	16 ...	9 mos. ...	25 „
8 ...	M. ...	19 ...	9 weeks ...	31 „
9 ...	M. ...	4 ...	9 „ ...	38 „
10 ...	F. ...	11 ...	2 years ...	2 „
11 ...	M. ...	10 ...	8 mos. ...	146 „
22 ...	M. ...	40 ...	3 weeks ...	4 „

CASE I.

Empyema—Antiseptic Incision—Cure.

John Agar, labourer, ætat. 31, admitted to Hospital, February 23, 1883.

Family history good; he says he has been a temperate man, and had no previous illness. The present illness commenced in the early part of December, 1879, with sudden acute pain in the right hypochondrium, followed by rigors. He was quite well until moment of onset, which took place when he was at his work, and since he has suffered from cough and wasting. There have been no diarrhœa nor night sweats, and he thinks he has improved somewhat lately, although during the last three or four weeks there has been œdema of the legs at night. He now complains of cough, accompanied by pain in the chest and general weakness. He is a pallid, unhealthy-looking man. Has slight short cough with scanty expectoration. He lies on the back and right side by preference, and sleeps also on the right side.

Thorax fairly formed, but not symmetrical. There is distinct bulging and fulness of lower right chest, especially in front. Flattening beneath both clavicles, and some impairment of movement of right chest, especially below.

In front, percussion note is fairly good, though a little "boxy" in character, and the note is a little higher at the left apex than the right. The breathing is everywhere coarse, and, at the lower part especially, bronchial. The voice sounds are not much altered.

Behind, there is marked dulness in lower right side. Breath sounds generally are loud and bronchial, and here and there accompanied by small râles. Over dull area the sounds do not present any alteration than those usually found.

Heart.—Impulse feeble. Sounds normal, and apex not not displaced.

Abdomen.—Liver and spleen not felt.

Urine.—Sp. gr. 1018. Acid. No albumen.

March 1.—The patient looks ill. There is still lowering of percussion note at right apex to be noted in front. Behind there is absolute dulness from the mid-scapular region downwards. The intercostal spaces present no alteration worthy of note. Over this dull area, the breath-sounds are audible, but diminished, and accompanied by fine râles. Voice resonance not much altered. Fremitus present, but less than on opposite side. Right chest explored in mid-axillary line, and pus found. Weight of patient, 8st. 11 $\frac{3}{4}$ lb.

March 2.—Right chest incised in about the eighth intercostal space with full antiseptic precautions. Six ounces of blood and pus escaped. Free hæmorrhage. Two drainage tubes introduced. Dressed under spray in the evening, when dressings were soaked with bloody discharge.

March 3.—Dressed. Much bloody discharge.

„ 4.—Dressed. Less discharge.

„ 19.—Got up for first time since the operation. Has gained five pounds in weight; now weighs 9st. 1lb.

March 21.—Dressings changed every other day. Very little discharge.

March 27.—Weight, 9st. 4lb.

April 2.—Dressed every fourth day. Moderate amount of discharge.

April 5.—Weight, 9st. 5 $\frac{1}{2}$ lb.

„ 12.—Weight, 9st. 6lb.

„ 17.—Weight, 9st. 9 $\frac{1}{2}$ lb. Scarcely any discharge from wound.

April 21.—Drainage tube removed. Small sinus only remains.

April 24.—Weight, 9st. 11 $\frac{1}{4}$ lb.

May 3.—Sinus closed. A little superficial sore to heal. There is now good resonance of whole of right chest posteriorly with good breathing and no adventitious sounds. No deformity of chest at present.

Remarks.—In spite of numerous deviations of the temperature curve, I am inclined to think the case may be described as one running a typically aseptic course. There was never any odour of putrefaction, and the fleeting nature of the deviations favours this view. They were probably due in most part to difficulties in drainage which arose from time to time.

Unfortunately the temperature chart of this patient was lost, and the exact deviations, mentioned in the final remarks of the house physician, cannot be stated. I am, however, in a position to affirm that before the operation the temperature was fluctuating; often high, and never normal.

This patient had a liberal diet, but no medical treatment.

CASE 2.

Empyema—Antiseptic Thoracentesis—Cure.

Thomas Jones, ætat. 40, Bricklayer; admitted
June 25, 1880.

June 27.—He says he has always been healthy and steady. Six weeks ago, when at work, he was suddenly seized with tightness in the chest, severe pain in the right side, worse on breathing, and with slight shivering. No vomiting. Six weeks previously he had worked for four days in falling water in an excavation, and was soaking wet for eight hours at a time. For a week there has been cough with abundant sputa. He is a spare thin man. Looks more than 40 years of age.

Chest—Capacious, but rather barrel-shaped. Expansion deficient at the right base, but elsewhere fair. In front; Left side rather hyper-resonant. Right side resonant as far as lower border of third rib; here there is commencing dulness which becomes absolute at the upper border of the fourth rib. Vocal fremitus annulled over dull areas, but is in no part of the chest easy to feel; vocal resonance also impaired. Respiratory sounds on right side of chest feeble; a few

rhonchi heard at the apex, and a rub (?) over the dull portion. On left side, sounds louder, expiration slightly prolonged; sounds in bronchi loud and well marked over their situation. Behind, no visible bulging. On the right side there is dulness as far as the eighth rib. Breath-sounds audible below the angle of the scapula. Fremitus and vocal resonance both unimpaired. Cardiac dulness cannot be distinguished, and apex beats in fifth interspace $\frac{1}{4}$ inch outside the nipple and $2\frac{1}{2}$ inches below it; sounds normal. There is troublesome cough, with expectoration of abundant frothy mucus, bronchial in character.

Urine acid, sp. gr. 1015. No albumen nor casts. Tongue moist and furred. Bowels open. Respirations 34. Pulse 84 per minute. Evening temperature, 101° ; morning temperature, 99° .

July 3.—Complains of pain in right side and between shoulders.

July 24.—The patient is now spitting up pus in quantity. Physical signs the same. Chest explored with aspirator needle and pus withdrawn.

July 26.—Chest opened under spray. Sixteen ounces of pus withdrawn. Two tubes inserted.

August 1.—One of tubes removed. Slight discharge on dressings.

August 23.—Antiseptic dressings removed.

September 17.—Patient left hospital perfectly well. Sinus healed. No deformity.

TEMPERATURE.—*Before Operation.*—During the 31 days he was in hospital before the operation the evening temperature was 23 times 100° or above 100° ; six times of which it was 101° or more, and twice above 102° . Thirteen times the morning temperature was 99° or more; at other times varying between 98° and 99° .

After operation.—On the same evening it reached 99.4° , then fell the following morning to 98.7° , and at night to 98° . Ever after it never rose above 98.8° , which was reached on three occasions only, the average variation between the morning and evening register being half a degree.

CASE 3.

Empyema—Antiseptic Thoracentesis—Cure.

James Kelley, ætat. 8, no occupation; admitted
September 16, 1879.

History.—He has been ill about three weeks with general malaise and loss of flesh.

Chest.—Right side apparently shrunk, and there is deviation of the spine to the left side. From spine to centre of sternum in nipple line, right side 11 in., left side 10 $\frac{3}{4}$ in. Movements of right chest much impaired. No bulging of intercostal spaces. Impure “boxy” resonance over front of right side. Percussion note on left side normal. Breath-sounds on right side harsh and loud, and vocal resonance increased. On left side, breathing loud and vocal resonance normal. Posteriorly—Upper part of right lung, resonance much impaired, which merges into absolute dulness at angle of scapula. Dulness extends laterally to the anterior border of the axilla. Voice and breath-sounds entirely absent at the base.

Heart.—Apex beats 2 $\frac{3}{4}$ in. from mid-sternum in the fifth space. Sounds clear. Liver and spleen not felt. Chest explored in ninth space with no result.

September 26.—Dulness diminishing, and not so high-pitched.

September 29.—General condition not so good. Line of dulness in axilla the same, and the signs of fluid remain.

October 4.—Chest again explored, and pus found in the seventh space, in axillary line. Urine 1010. No albumen.

October 9.—The physical signs remain in all respects the same as on admission, but the general condition is gradually deteriorating. Ether having been administered, Mr. Teale incised the

right chest, between the seventh and eighth ribs, a little behind the axillary line, under full antiseptic precautions. Eighteen ounces of sweet pus escaped, with some recent blood. Two drainage tubes introduced, and fixed to side of wound by means of sutures, and the usual antiseptic dressings applied.

October 10.—Dressed. Considerable discharge. Temperature normal since operation.

October 11.—Dressed. Less discharge. which is quite sweet. No pain in chest.

October 12.—Does not require dressing. Appetite bad.

„ 20.—Dressed every other day since last note. Very little discharge indeed.

October 27.—One of drainage tubes had slipped into chest, causing slight accumulation of pus. This would account for slight rise of temperature last night. Discharge sweet. One tube left out.

October 30.—Dressed. Very little sweet discharge. Drainage tube shortened half an inch.

November 4.—Dressed, and drainage tube shortened to one inch. No discharge.

November 22.—Dressings during last fortnight have been left four or five days unchanged, there being little or no discharge. Drainage tube removed on seventeenth day from operation. The pleural cavity is now closed, and the external wound healing rapidly.

November 25.—Antiseptics discontinued; wound entirely healed.

December 5th.—Deviation of spine, and flattening of right chest gone. No difference in measurements of each side—11 $\frac{7}{8}$ in. Expansion impaired at extreme right base; otherwise fair. The percussion note is now good over the whole chest, except on right side below the level of the incision, though here the dulness is not absolute. The breathing and voice sounds are also good, except over dull area. The breath sounds are distinct, though feeble, over the dull area, and the voice sounds cannot be heard.

December 13.—Patient left hospital the picture of robust health.

Weight.—

			St.		Lbs.
September	22	...	3	...	5
October	17	...	3	...	0
"	22	...	3	...	3 $\frac{3}{4}$
"	29	...	3	...	7 $\frac{1}{2}$
November	6	...	3	...	10
"	13	...	3	...	11 $\frac{1}{2}$
"	28	...	4	...	0
"	27	...	4	...	0
December	4	...	4	...	1
"	11	...	4	...	2

Treatment.—From admission to October 12.—Mist. Ferri Perchlor. $\frac{1}{2}$ an ounce three times a day.

For which on October 12.—Mist. Quinæ Sulph. $\frac{1}{2}$ an ounce three times a day was substituted.

Liberal diet, including three eggs daily.

TEMPERATURE.—*Before Operation.*—Typical hectic temperature. During 17 days before operation evening temperature only once below 102° (101·8°). Five times 103° or more and four times 104° or more. Morning temperature four times 99° or less and nine times above 100°.

After Operation.—The temperature fell the same night to 97·2°, rose the following night to 99·4°, and during the following eight weeks only rose three times again above 99°, but never reached 100°.

CASE 4.

Empyema—Antiseptic Thoracentesis—Cure.

Ada Telford, ætat. 5, admitted 15th June, 1880.

History.—Until 14 weeks ago, she was a strong healthy child, "as fat as a little pig." She was found in the morning lethargic and complaining of pain in the head, having gone to bed the night before quite well. Family history very good. She is a thin small child.

Fingers clubbed and nails convex ; veins of extremities prominent. Pearly conjunctivæ, long eyelashes and silken hair.

Chest.—Both sides symmetrical. The right is flattened in front, bulging into the axilla ; and the intercostal spaces are obliterated. The left nipple is $2\frac{1}{2}$ inches from the sternum, the right 2 inches. Expansion deficient over the whole of the right side, especially the base ; and, in front, the percussion note above the fourth rib is much impaired, with some improvement at the apex. Below the fourth rib there is complete dulness, and below the third rib the respiratory sounds are absent. At the apex the breathing is louder and harsher than ordinary puerile respiration, with prolonged audible expiratory murmur. The left side is resonant throughout, respiratory murmur good, and there is no prolonged expiration. Behind, there is complete dulness below the sixth rib, and impaired resonance above it. Respiration can, however, be heard all over. She lies on the right side. Heart's apex beats in the fifth interspace just inside the nipple line and $1\frac{1}{2}$ inches below the nipple. There is frequent painless moist cough, without expectoration.

June 28.—Chest explored and pus found.

„ 21.—Incision under spray. Nine fluid ounces of pus evacuated.

July 1.—One tube removed. Child much improved.

„ 9.—There was slight rise of temperature, and on the chart are the words “ blocking of tube, with serous accumulation.”

July 28.—Antiseptic dressings removed. Wound healed except small redundant granulation.

August 3.—Made out-patient. There is slight retraction of the chest wall with diminished resonance behind, and breath sounds are audible all over, with somewhat diminished intensity on the right side.

TEMPERATURE.—For a week before operation, with exception of rise on two evenings to 99° and 99.6° , normal; after operation; during the six weeks which intervened before patient's discharge, temperature normal with exception of seven evenings, when it twice reached 99.2° and five times 99° .

CASE 5.

Empyema—Antiseptic Thoracentesis.—Cure.

Millicent Fox, ætat. $4\frac{1}{2}$, admitted May 17, 1880.

Family History—Good.

Patient was a strong, healthy child up to present illness. Began by complaining of being cold and sick eleven weeks ago, vomiting five or six times during first day and night. Then complained of much pain in the left side. Had a bad cough, but spat very little. About a fortnight ago first noticed left side was swollen, and during last week cough has been accompanied by rather more expectoration.

She is a thin, pale-looking child, large brown eyes, square forehead, and silken hair. Breathing rapid and shallow. Lies on right side, and looks extremely ill. Left side of chest looks bulged and rounded, and does not expand on inspiration, and intercostal spaces are lost. Over most prominent portion of chest wall, third and fourth spaces a little outside nipple, superficial veins are visible from expansion. No breath sounds can be heard, but there is no absolute dulness, though there is marked diminution of resonance over the whole of left side, most marked in axillary line on level with nipple.

May 17.—Chest opened antiseptically. Sixteen fluid ounces of pus removed.

June 6.—There has been marked improvement following operation. Patient is lively and comparatively well.

June 13.—Dressed. Tube had come out into dressings, and wound was found quite closed. Improvement in general condition still continues.

June 17.—Dressings left off. There is still considerable dulness in left lung, behind. Air can be heard entering the whole of lung. Breath sounds fairly normal. Wound is quite healed. Temperature normal.

TEMPERATURE.—No record before operation. During first week after operation, three times reached 99° and once 99.6° . Normal throughout afterwards.

CASE 6.

Empyema—Antiseptic Thoracentesis—Cure.

William Lord, ætat. 20, Warehouseman, admitted February 19, 1881.

Family History.—Mother died of consumption, ætat. 39. Two sisters died in infancy. He had bronchitis when seven or eight years old, but he has had no other illness. He was at work and well six weeks ago.

Illness commenced suddenly six weeks ago on a certain Saturday. Pain in back and side. No rigor. No cough till some few days afterwards. During first few days, no symptoms, except indefinite pains about back and loins. Cough has gradually increased. Shortness of breath began to trouble him three weeks ago. Has wasted. Profuse sweatings. Never hæmoptysis.

A delicate-looking man with frequent irritable cough. Skin bedewed with sweat of a strongly sour rheumatic odour. Lies easily in any position, except that sometimes he cannot lie on left side on account of pain his doing so induces. Somewhat wasted. Fingers not clubbed. Respirations 40. Pulse, 132 per minute.

Thorax.—Length, a little increased. Antero-posterior diameter below average. Epigastric angle normal. There is perhaps a little want of symmetry, apparently from slight shrinking of left side. Circumference at nipple level $3\frac{1}{2}$ inches. Tegument and surface pale; otherwise no unusual condition.

There is great want of expansion on left side, especially in lower part of chest. Interspaces not altered.

On Percussion—Left side, there is tympanitic or sub-tympanitic note from extreme apex to level of stomach resonance—6th rib—and extending laterally to middle line and anterior border of axilla. This resonance has entirely replaced the normal cardiac dulness. Behind there is absolute dulness from spine of scapula to extreme base, the percussion gradually becoming more soundless as one descends.

On Auscultation—Harsh high-pitched breath sounds can be heard entering lung in 2nd and 3rd spaces in front, but otherwise little or no sound is to be heard in left chest. The vocal resonance at left apex is perhaps a little intensified, but in other parts entirely absent. Vocal fremitus is entirely absent over the dull area.

Right Lung—Resonance good. No dulness. Breath and voice sounds a little increased in front; otherwise clear.

Heart.—There are evidences of considerable displacement, for while the cardiac dulness, as above mentioned, is entirely obliterated in left chest, distinct cardiac impulse is visible in right 4th and 5th spaces, a little outside edge of sternum; but there is no distinct dulness. To the hand, although some impulse is felt on left of sternum, by far the most powerful is on the right side in the locality mentioned.

Urine.—Sp. gr. 1028. Loaded c. lithates. No albumen.

Feb. 25.—Left chest explored and pus found.

„ 28.—Chest incised under strict Listerian precautions. 47 fluid ounces of laudable sweet pus evacuated. Ether given.

Mar. 2.—Urine slightly tinged brown (carbolism). Sp. gr. 1022. Precipitate with cold nitric acid, disappears on boiling.

„ 8.—Getting up daily during last week.

Mar. 18.—Dressed now every four days. Just a little serous discharge at each dressing.

„ 21.—Weight, 9 st. 11½ lb. Weighed 11 st. 12 lb. before illness.

April 10.—Healed.

TEMPERATURE.—*Before Operation.*—During 9 days prior to operation was never below 100°, twice 102° and four times above 101°. On the morning after admission it reached 103°, and afterwards was three times below 99° and twice above 100°.

After Operation.—The same evening it fell to 98·2°, not having previously been below 98°. Until the middle of the third week it was once only above the normal standard, and then reached 99·4°: and a subsequent rise to 100·2° on two evenings corresponded to a sore throat which the patient had. When this subsided, the temperature fell to the natural limit.

CASE 7.

Empyema—Antiseptic Thoracentesis.—Cure.

Mary Harrabin, ætat. 16, no occupation, admitted 1st June, 1881. Discharged 23rd July 1881. Well.

She was quite well up to nine months ago, when she got cold, shivered very much, and went to bed complaining of pains all over. Cough has continued, and she has been confined to bed more or less ever since. Has lost much flesh, and had occasional night sweats. Has never had much pain in one particular place. Since commencement of illness she has always lain on the left side.

Condition—A pale thin girl, obviously suffering from some wasting disease. Hands much wasted, fingers clubbed.

Chest is small, very badly formed, two sides not symmetrical. Integument very thin, superficial plexus of veins distinctly visible. Sternum much arched forwards, especially at lower part. Left side rounder and more bulged than right, and

intercostal spaces not so well marked. Expansion of two sides unequal, right side expanding much more than left. Circumference, of each side just below nipple, equal.

Percussion in front, on right side, note is not much altered, but at left side there is almost complete want of resonance, most marked below the nipple. Behind, on right side, note is rather boxy; on left side there is considerable comparative dullness above; becoming absolute at angle of scapula.

Auscultation on right side, breathing is tubular in character, and accompanied by sibilant rhonchi, both in front and behind. In left lung, in front, breath sounds are distant and indistinct; behind, breathing is coarse and harsh, above; and at lower part entirely wanting. Vocal resonance and vocal fremitus both considerably impaired on left side of chest.

Heart.—Apex difficult to define, probably in fourth space, two inches from mid-sternum. There is a soft systolic murmur at apex, not audible behind, but faintly so at base. Pulse 120, regular—soft.

Urine.—Faintly alkaline, Sp. gr. 1015. Contains phosphates, on boiling.

There is frequent cough with much sputa; about 18 ounces in 24 hours, frothy, viscid, and purulent. Not offensive.

June 4.—Left chest opened antiseptically. Twenty-four ounces of pus removed.

June 6.—Has been much relieved by treatment. Cough not so frequent; not more than two fluid ounces of sputa in 24 hours. Carboluria.

June 8.—Marked improvement in general condition. Cough almost entirely gone. Appetite improving. Dressed third time, discharge very slight, chiefly serous.

June 22.—Dressed for fifth time. Discharge slight, perfectly sweet. Cough nearly gone. Air can be heard entering left lung at base, breath sounds

good, though rather indistinct, but dulness is still well marked. At apex, note is quite clear, and breath sounds are good and distinct.

June 29.—Quite healed. Temperature normal. No cough. Gaining flesh rapidly.

TEMPERATURE.—*Before Operation.*—During three days temperature only once below 99° and once above 100° (100.2°).

After Operation.—During four weeks only once above 99° (99.7°).

CASE 8.

Empyema—Antiseptic Thoracentesis—Cure.

John Wade, ætat. 19, Cloth Dresser, admitted March 24, 1880; absconded 17th June, 1880, well.

Patient was quite well three weeks ago. Seventeen days ago indulged freely in beer, and when attending a "wake," he appears to have fallen asleep in the cold. In two days was seized with lacerating pain in the left side, feverishness (no shivering), cough, with expectoration of thick frothy mucus. Has lost considerable flesh during last fortnight, and his voice has become harsh and husky. Previous to the above attack, has always enjoyed good health.

Patient is a pale-looking lad. Alæ nasi dilated, skin hot and dry. Voice hoarse and very indistinct. He complains of lacerating pain in the left infra-mammary region, and cough, as above.

Chest.—Expansion on left side deficient, and intercostal spaces also here indistinct.

On percussion in front, on left side, there is dulness extending from apex all along front of chest, increasing towards base of lung. Vocal fremitus lessened, and respiratory sounds decreased, and accompanied by coarse mucous râles. Right lung, with the exception of occasional râles, appears to be tolerably healthy.

Behind, there is a marked difference on inspection. The ribs on the right side, to the outer side of

the scapula, appear much sunken in, as compared with the left.

There is almost complete dulness over the whole area of the left lung, increasing from apex to base. Respiratory sounds just audible at apex, but entirely deficient at base.

Vocal fremitus much lessened; vocal resonance, if anything, slightly increased.

Heart Sounds normal. Apex beats just below sixth rib, $1\frac{1}{2}$ inches from mid-sternum. Impulse visibly increased.

Urine.—Acid; 1018. Loaded with albumen and chlorides.

April 3.—Physical signs the same. Urine still albuminous.

April 12.—Not so well; losing flesh.

„ 16, 11 a.m.—Left chest incised under ether. Twelve fluid ounces of pus and blood escaped. Strict antiseptics.

7-30 p.m.—Dressings soaked with discharge. Redressed.

April 17.—Discharge does not show through dressings. Great nervous disturbance (hysterical). Urine dark coloured. (Carbolism). Sp. gr. 1025. Acid. Still albuminous.

April 30.—Weight, 7st. $11\frac{3}{4}$ lb.

May 3.—Urine still albuminous.

„ 8.—Weight, 8st. $7\frac{1}{4}$ lb. Very little discharge. Urine albuminous.

May 15.—Weight, 8st. $9\frac{1}{4}$ lb.

„ 21.—Weight, 8st. $11\frac{1}{4}$ lb.

June 10.—Weight, 9st. 4lb. Drainage tube removed.

„ 17.—Patient absconded.

Remarks (by the House Physician).

A simple case of empyema opened and dressed with strict antiseptic precautions.

Allowed to get up ten days after operation.

Dressings every three days on an average.

Tube removed at end of eight weeks.

Three days after removal of tube patient absconded; the wound not quite closed.

TEMPERATURE.—*Before Operation.*—Typical hectic variations. During 23 days before operation, only five times was morning temperature below 100° and did not then reach lower than 99.2° . Evening temperature was twice 104° , and six times between 103° and 104° , and, except on two occasions, always above 101° .

After Operation.—During eight and a half weeks, 101° five times (once in morning), twice 100° ; on ten occasions above 99° , and 99° or below that height during remainder of treatment. More irregular than in other cases.

CASE 9.

Empyema—Antiseptic Thoracentesis—Cure.

Fred Swales, ætat. 4. admitted 8th May, 1880.

Discharged 4th July, 1880. Well.

Child was always strong until this illness. Nine weeks ago the present illness commenced by sickness, feverishness and pain in the left side; having been, the day previously, struck with a stick on the same side of the chest. He has lost flesh since. A well-developed rather thin child.

Chest.—Well formed, no bulging. Behind, the left side is less resonance than the right throughout, and in front, below the third rib, there is loss of resonance on the left side. Respiratory sounds are audible but feeble, over this area on the left side, but there is no difference over the bronchi or apices, and no hyper-resonance at the left apex. Expansion greater on the right side than the left. There is no high pitched dulness at lower part of left axilla.

Heart sounds normal, loudest over fifth rib. $\frac{1}{4}$ inch within the nipple line. Apex beat not found. Tongue clean and he takes food well. Has occasional, but persistent, cough, not hacking nor dry, and it is painless.

May 19.—There is now complete dulness below the angle of the left scapula. Temperature last night 101°.

May 25.—Incision made in axillary line, and twenty fluid ounces of pus evacuated.

June 19.—Tube removed. No discharge.

July 4.—Wound completely and firmly healed since 2nd. inst.

TEMPERATURE.—Once before operation, 101°. Not a hectic range. Afterwards, normal.

CASE 10.

Empyema—Phthisis—Pulmonary Fistula—Thoracentesis Death.

Charlotte Winsbury, ætat. 11, admitted 29th June, 1880. Death, 4th July, 1880.

A thin, dark-haired child. Skin thin, conjunctivæ pearly, pupils large, skin around eyes dark, and there is a faint yellow tinge around otherwise pale face, Hair silken, and fingers clubbed. Palpebral conjunctivæ pale.

She lies in bed resting chiefly on the left side, and cannot lie on the right side because cough then comes on.

History extends over two years.

Chest.—Small and rickety. Narrowed in front. Ribs well marked and the left first rib is visible. There is flattening of both apices, most marked on the left side, where expansion is very deficient. Left side throughout less resonant in front than the right, and there is dulness at both apices. On auscultation, there are no marked signs. The breathing is in excess of puerile respiration in loudness. No bubbling sounds, but numerous crackling small râles at the apices.

Behind, there is dulness at the apices, and the resonance all over is somewhat impaired. On auscultation, the same sounds are heard, and on both sides they extend to the middle of each lung, but are most numerous above. They are

not heard on each inspiration below, and some of them may be pleuritic rubs. On the left side there is dulness at the base, and on aspiration with exploring syringe, pus was evacuated.

There is troublesome cough, with expectoration of almost unmixed fœtid pus. P. 120. Respirations, 54 per minute.

Appetite poor, and she frequently vomits after meals. Tongue moist and pale. No diarrhœa, but rather a tendency to costive bowels. There are night sweats, and sleep is much disturbed by troublesome cough.

July 2.—Opening made in axillary line at level of the nipples in position of puncture of yesterday. No pus evacuated. Strict antiseptic precautions; and antiseptic dressings applied.

July 3.—Abundant fœtid discharge on dressings, the lower portion being soaked in pus. No accumulation in the chest. Cavity washed with carbolised water (1-100), and sudden dyspnœa, with cough and expectoration of thin semi-purulent liquid, which produced a hot taste in the mouth, produced.

July 3.—Death.

On *post-mortem* examination, the whole of left lung was found solidified, and riddled with small abscesses, apparently connected with tube. Empyema small. Localized opening by a wide aperture into a cavity at base of lung, which communicated freely with trachea, by means of of a large bronchiole

No lardaceous disease.

TEMPERATURE—

		Morning.		Evening.
June	29. ...	—	...	100°
„	30. ...	99°	...	101°
July	1. ...	99°	...	99·6°
„	2. ...	101·4°	...	99·7°
„	3. ...	99°	...	99·8°
„	4. ...	97·4°	..	97°
„	5. ...	96·4°	...	98·6°

CASE II.

Pleuritic Effusion—Empyema—Thoracentesis—Cure.

William Smales, ætat. 10, admitted March 12th,
1879. Discharged 1st July, 1879.

March 13.—One pint eight fluid ounces of straw-coloured serum drawn off by aspirator.

April 2.—Twelve fluid ounces of serum drawn from right pleura (as much as would run).

April 19.—Right chest tapped with small trocar and canula, in apparent ninth space. Trocar, with long tube under carbolic acid, left *in situ* for eight hours, during which $42\frac{1}{2}$ fluid ounces of turbid straw-coloured serum were drawn off. Complained of a good deal of pain in chest at the time. Fluid drawn off shews abundant pus cells.

May 30.—Right chest again tapped, and 21 ounces of turbo-purulent fluid drawn off. This fluid, on standing, yields half its quantity of thick pus, as shewn by microscope. It is quite sweet.

Re-admitted August 20, 1879; discharged
September 2, 1879.

Improved. Signs of fluid in right chest, but expectant treatment only followed.

Re-admitted November 26, 1879; discharged
May 6th, 1880. Well.

General condition satisfactory.

In recumbent posture, there is absolute dulness, commencing in front on the second rib, and continuing throughout lateral and anterior aspect of right chest. Behind, in erect posture, there is a small area of resonance in supra-spinous fossa; otherwise, whole posterior wall is dull also, the only area of resonance being thus situated over the apex. On right side, impure breath sounds are heard at extreme apex and beneath clavicle, and a narrow band in posterior wall

running beside the spine. Urine sp. gr. 1004. Acid. No albumen. No sugar.

December 5.—Æther given, and chest incised by house-surgeon, in about seventh space. Strict anti-septic precautions. Fourteen fluid ounces of pus collected, but probably more than a pint escaped altogether. Two drainage tubes introduced and fixed to edge of incision. At 10 p.m., owing to insecure fixing of the dressing, the whole thing slipped, and probably drainage tubes were exposed; but on this point evidence is conflicting. The dressing was at once re-applied, the original dressing being drenched with discharge.

December 7.—Dressed yesterday and to-day. Perfectly sweet. Drains acting well. General constitutional disturbance, *nil*. No discomfort.

December 13.—Fourth dressing after three days interval. A drachm or two of discharge only.

December 15.—Fifth dressing. There was some evening rise of temperature during last two nights—100° and 101°. Both drains completely blocked with curdy pus, and considerable accumulation in pleural cavity in consequence. Quite sufficient to explain rise of temperature.

December 17.—Temperature last night rose to 102°. Drains completely blocked with large masses of curdy pus. On removing the drainage tubes, five fluid ounces of pus, containing hard masses of inspissated matter, escaped. The two small tubes removed, and one of $\frac{1}{3}$ inch bore introduced. Pus quite sweet.

Weight.—

			St.		Lbs.				St.		Lbs.
Jan.	9	...	3	...	10	Feb.	4	...	4	...	0 $\frac{1}{2}$
	16	...	3	...	12 $\frac{1}{2}$		18	...	4	...	0
	23	...	3	...	13 $\frac{1}{2}$		25	...	4	...	0
	28	...	4	...	1 $\frac{1}{2}$	Mar.	10	...	4	...	0
							31	...	4	...	1

TEMPERATURE.—*Before Operation.*—For nine days prior to operation, evening temperature six times 100° , or between 100° and 101° , and three times between 99° and 100° . Morning temperature, seven times 98.4° , and once 98.8° .

After Operation.—Treatment continued for $19\frac{1}{2}$ weeks. From 10th to 16th day, evening temperature never below 100° , twice 101° and once 102° . This corresponded with blockage of tube by curdy pus, and on 25th day after operation there is a solitary evening rise to 101.6° , and a note on chart that patient “has taken cold.” During remaining period, temperature indicated an aseptic course and was never above 100° , which point was reached on four occasions.

THE FIBRINO-SEROUS EFFUSIONS.

Cases 12—21 and 23—38 inclusive.

Having described the practice we adopt in the treatment of pleuritic effusion, we suffer many regrets because we have not preserved notes of all the cases we have treated, including, as they do, hospital as well as private patients, in different stations of life, with good results. Regrets, however, are vain, and we must be content with the material available, which is of considerable value.

Some of the cases are treated by complete evacuation of the fluid, but for this we were not responsible. In some, also, the aspirator was used; but this has been superseded entirely by the syphon tube, at the hospital from which the cases are drawn.

The cases not tapped show the safety of treatment by drugs in appropriate cases, whilst the cases tapped, as clearly demonstrate the advantages and safety of the operation, judiciously performed.

The division of the cases into the groups “simple,” “complicated,” and “hydrothorax,” may not be altogether a reliable one, but it is as correct as possible. The reader will appreciate the difficulties of a satisfactory

arrangement under these heads, for it is sometimes impossible, after careful examination, to determine whether a case we are treating is simple, or whether the pleurisy is the secondary result of a complicated pathological state.

PLEURITIC EFFUSIONS.

	Nos.	
Simple cases (inflammatory effusion)	$\left\{ \begin{array}{l} 18 \\ 20-3-5-6-6A-7-8-9 \\ \hline 30-1-2-3-4-5-7-8 \end{array} \right\}$	17
Complicated cases (Hydrothorax...	12-14-16-19	4
Phthisis ...	15-36	2
Pneumonia ...	13	1
Tuberculosis ...	24	1
Hydatid of lung	21	1
Physical signs of fluid, but none withdrawn, No. 17		1
		—
		27
		==

Simple cases :

	Deaths.	Mortality.	Average stay in Hospital.
Cases tapped ...	14	2 ... 14.28%	33.38
Cases not tapped...	3	0 ... 0.0	28 days

Complicated cases :

	Average stay in Hospital.
Cases tapped—	
4 Hydrothorax ...	60 days
2 Phthisis... ...	0 ... 0
1 Tuberculosis... ...	1 ... 100% ... 59 days
1 Hydatid of lung ...	0 ... 0 ... 96 days
Cases not tapped—	
1 Acute pneumonia ...	0 ... 0 ... 28 days
1 No fluid... ...	0 ... 0 ... 19 days
	—
	3
	11%
	—

General Results of Operation :—

9 Cured...	23	25	26a	28	29	31	32	34	35
1 Much relieved...	21								
5 Relieved ...	12	16		18	20	36			
2 Worse ...	15	19							
3 Died ...	24	27	37						
2 Not stated, or discharged at own request...	14	17							

Of the deaths, case 24, one of general tuberculosis must have inevitably ended fatally. Case 27, I remember well, for from accumulation of work, owing to absence of the acting house-physician from home, the gravity of the case was overlooked, and when the last aspiration was performed, the patient, as stated in the notes, was evidently sinking. The remaining case, 37, was one of long-continued excessive accumulation, and earlier operation would in all probability have saved the patient's life.

Immediate effects of the operation :—

	Nos.
Breathing much relieved in 2 cases.	14-16
Dyspnœa before operation ;	
relief after 3	„ 18-22-23
Much relieved 5	„ 19-24-25-26a-28
Better 2	„ 35-36
Breathing easier after ... 1	„ 12
No marked improvement... 3	„ 27-32-37
No details 4	„ 20-29-31-34
In <i>statu quo</i> (discharged at own request) 1	„ 17

*Number of times cases were tapped :—**Simple cases :*

Once tapped	18	20	25	26a	28	29	31	32	35
Quantity removed	26oz.	220c.c.	142oz.	158oz.	128oz.	68oz.	90oz.	48oz.	17oz.

Twice tapped :

Case 34	37
Quantity 24 ounces ...	?
21 do. ...	9 pints.

Thrice tapped :

Case 23—

Quantity—17 ounces.

4 pints.

3½ do.

*Complicated cases :**Once tapped :*

Case 12 ... 14 ... 15 ... 16 ... 19

Quantity—3 pints 3¼ pints ½ pint 16 oz. 58 oz.

Four times tapped :

Case 24—

Quantity—3 ounces.

2½ pints.

23 ounces.

1 pint.

Other features of the cases :

In 1 case	Albuminous expectoration	...	...	19
„ 2 „	Dyspnœa necessitating withdrawal of canula during flow of fluid	...	...	19-24
„ 1 „	Chest dull, but no fluid found on tapping	...	...	17
„ 1 „	Fluid turned from fibrino-serous to purulent character	...	...	11
„ 2 „	Fluid sero-purulent, became purulent	...	...	22-27

CASE 12.

Cardiac—Hydrothorax—Tapped—Relieved.

Isaac Foster, ætat. 41, Stone Dresser in Cloth Mill, admitted August 25th, 1881. Discharged October 1st, 1881. Better.

Never had rheumatism, and history dates from twelve months since when cough, shortness of breath, and vomiting came on. The symptoms have gradually become worse.

August 31.—*Heart*.—No cardiac thrill to be felt. Apex beat cannot be found. Dulness perhaps a little large. Impulse obscure. Systolic bruit at apex. General signs of bronchitis.

Lower third of right chest behind is almost absolutely dull, with absence of vocal fremitus.

September 16.—Right chest tapped with Roberts' trocar. Three pints of clear straw coloured fluid drawn off. Trocar removed on account of shortness of breath.

September 17.—Much better.

„ 19.—Better. Breathing easier. Cough less. Dulness at right base still exists, but to less degree. Fremitus still absent.

CASE 13.

Acute Pneumonia, with physical signs of fluid on affected side.

Emily Inman, ætat. 18, Millhand, admitted March 18th, 1881. Discharged well April 15th, 1881.

March 23.—Admitted March 18th, obviously suffering from some acute disease. Temperature 105°. She said that she had been ill and unable to work for a month previous to this, but could give no definite information as to nature of ailment. She looked feeble, very ill and wasted, and somewhat neglected. Large patches of herpes about angles of mouth, apparently of some few days' standing. This led to examination of the chest, for she complained of little beyond shortness of breath.

Chest on day of admission.—Hyper-resonant percussion note at left apex. Dulness over lower third of left lung behind, with high-pitched whiffing tubular breathing. No crepitations. Whispering pectoriloquy, but total absence of vocal fremitus. This latter sign obscured the diagnosis considerably, and on the 21st inst., the general condition having become somewhat worse, two exploratory punctures were made, over site of lesion, but with

negative result as regards pleuritic effusion. It must be noted that some change had taken place in the physical signs, viz:—The addition of coarse superficial crepitations and a diminution in dulness. The fremitus still remained absent. Salicylate of soda had been administered on admission, and was followed by a rapid fall of temperature to 97°.

She has now been taking salicylate of soda since evening of 21st, when temperature reached 103°. This morning says she is better. Breathing tranquil, but frequent.

Dulness persists at left base. The auscultatory signs are a little indefinite. Fremitus present and increased.

March 26.—The physical signs are not much altered. There is the same area of impaired resonance with tubular breathing and whispering pectoriloquy. A few large bronchial râles. The fremitus is still indistinct. General condition remains a little better. Pulse 80, very feeble.

April 4.—Since last note there has been rapid and continuous improvement, both in the general condition and physical signs. The temperature has not at any time been above 99.° Appetite and strength are returning rapidly.

The patch of dulness has almost entirely disappeared, though the percussion note is of somewhat boxy character. Vocal fremitus very faint on both sides. The breath sounds are much improved, the normal vesicular murmur having returned over the greater part of the affected area. A few large bronchial râles. Vocal resonance still somewhat greater than on opposite side.

CASE 14.

Hydro-thorax and Ascites—Paracentesis Abdominis and Thoracis.

Hannah Nettleton, ætat. 23, no occupation, admitted 31st Jan., 1881; discharged April 23, 1881.

History.—She was in the hospital $4\frac{1}{2}$ months ago (see case 16), suffering from ascites and pleuritic effusion, the cause of which was obscure. Discharged somewhat relieved; physical signs somewhat improved. Except during first week after leaving hospital, she was entirely confined to bed. The history is one of gradual painless enlargement of the abdomen, accompanied with dyspnœa and œdema of the legs.

Condition on Admission.—She is a sallow, dusky-skinned woman, who bears the aspect of general debility and anæmia, rather than that of acute illness. Marked pallor of conjunctivæ and lips. Lies in natural attitude with easy breathing, except on exertion or talking. Has no pain, but complains much of general weakness. No satisfactory examination of lungs made, on account of inability of patient to sit up.

Heart.—Impulse diffused, but visible as high as third left cartilage. In third, fourth, and fifth spaces, close to sternum, there is marked undulation passing outwards, only visible during expiration, and most distinct in third space. Apex beat most distinct in fifth space, $4\frac{1}{2}$ in. to left of mid-sternum, being displaced upwards and outwards. Cardiac dulness begins somewhat abruptly in third space, passes downwards and outwards to apex beat in fifth space. Not increased to right of sternum. Sounds somewhat confused. First sound reduplicated and impure, but not a distinct bruit; marked "cantering." Second sounds clear, but reduplicated. Pulmonary accentuated.

Urine.—Deposits urates in abundance. Acid, sp. gr. 1020. Faint trace of albumen with cold nitric acid.

Abdomen.—Uniformly distended, and dull on percussion, except in loins and epigastrium. Distinct fluctuation.

February 10.—Nineteen pints eighteen fluid ounces slightly opalescent serum withdrawn by paracentesis abdominis.

February 14.—Lungs—Rhonchi; moist sounds and harsh breathing in front. On right side in front, there is absolute dulness from fourth rib downwards.

Behind, on right side there is marked impairment of resonance as high as spine of scapula, deepening into absolute dulness at extreme base.

February 15.—Urine sp. gr. 1010. Cloud of albumen on boiling.

February 21.—Urine sp. gr. 1015. Albumen, one-fourth.

February 24.—Urine sp. gr. 1020. Albumen, one-half. No casts found.

February 25.—Dyspnœa. Feeling of uneasiness and pressure after food. Signs in chest the same.

March 3.—Right chest aspirated. Three pints and four fluid ounces clear pale serum drawn out. Breathing much relieved afterwards.

March 7.—Paracentesis abdominis. Twenty-three pints clear straw-coloured serum withdrawn. The margin of the liver can now be felt through the flaccid abdominal wall, reaching within an inch from the umbilicus.

March 11.—Urine sp. gr. 1015. Albumen, one-fifth. General condition much relieved.

March 31.—Paracentesis abdominis. Eighteen pints clear straw-coloured serum. Urine 1020; albumen, one-fourth.

April 6.—Dyspnœa returning. Right chest dull, as high as spine of scapula behind.

April 19.—Paracentesis abdominis.

CASE 15.

Phthisis—Pleuritic effusion—Aspiration. Worse.

James Knowles, ætat. 18. Boiler Maker,

Admitted 9th May, 1881. Discharged 18th June,
1881, *worse*.

Chest—*In front* there is no dulness, though percussion note is not of good character. Breath sounds harsh, and prolonged at both upper lobes. Below level of third rib on right side the harsh breathing is accompanied by frequent sharp cracklings.

Behind—Dulness not quite absolute in right chest from angle of scapula, or a little above, to lower limit of lung. The dulness is not particularly high pitched in character. Breath sounds of a kind are audible over this dull area, but in axilla are almost entirely absent. There is no very definite change in vocal resonance, but vocal fremitus is decidedly impaired. Above dulness, occasional cracklings are heard as in front.

Left lung—Resonance fairly good. Breath sounds everywhere accompanied by small crepitations.

Heart—Apex in 5th space unusually near sternum. Sounds clear.

May 18.—Chest aspirated yesterday. Ten fluid ounces straw coloured serum drawn off. Urine sp. gr. 1020. Loaded with lithates. No albumen.

May 22.—Dulness at right base is diminishing. Vocal fremitus now rather increased than otherwise.

June 1.—Dulness at right base less. Percussion note at *right apex* decidedly higher in pitch than left. Breathing harsh and hampered. Vocal fremitus and resonance increased at right apex.

TEMPERATURE.—The typical phthisical variations.

CASE 16.

Hydro-thorax and Ascites—Paracentesis abdominis and thoracis.

Hannah Nettleton, ætat. 22, no occupation.
Admitted 23rd July, 1880. Discharged 18th
September, 1880. Relieved. See case 14.

July 30.—Eighteen weeks ago she was delivered of her third child, after a labour more easy than the previous ones. During her pregnancy she enjoyed good health, and beyond œdema of feet there was nothing noteworthy. There was no œdema of the hands. She was attended by a midwife, and got up five days after delivery. Remained well until ten days after delivery when the feet began to swell, this being followed by swelling of the body, and back of the hands. There have been no pains in the legs, and she has been in bed since ten days after delivery. Lochia lasted ten days only, and had an offensive smell, different from that of previous deliveries. Since their cessation there has been a thick white, not offensive, discharge.

A small but fairly nourished woman. Lips and palpebral conjunctivæ very pale. General expression dull and heavy, and suggestive of cardiac or renal disease. Then follows description of abdomen distended by ascitic fluid.

Chest.—Small, but fairly well formed.

In front—Lungs resonant. Breathing at apices coarse, but there are no râles. At bases cooing and whistling rhonchi.

Behind—There is dulness with diminished intensity of breath sounds. Elsewhere lungs are resonant, but the breathing coarse. Heart sounds clear, but first sound reduplicated at apex.

Pulse 90, regular, but feeble; respirations 32. Troublesome cough, with expectoration of yellow sputa. No blood. Slight œdema of arms and hands.

August 3.—Abdomen tapped with Roberts' small trocar. Eight and a half pints of ascitic fluid withdrawn. Urine sp. gr. 1012. Slight albumen.

August 6.—Complained of shortness of breath during last two days. Dulness on right side, in front from fourth rib downwards, with signs of fluid.

August 17.—Right side of chest aspirated and 16 fluid ounces of opaque white fluid removed.

August 18.—Breathing much relieved.

September 7.—Says she is very much better than on admission, though she still looks ill. Skin generally pale and dusky. Slight hard œdema of feet. Abdomen still contains a moderate amount of fluid. Still requires to be propped up in bed; and there is moderate dyspnœa, usually a little worse at night. She gets up a little every day.

Right chest.—Almost absolutely dull below angle or scapula, with much impaired breath and voice sounds. Fluid.

Heart.—Visible, rather forcibly, throbbing over whole of precordia. Most definite impulse (? apex) in sixth space, $4\frac{1}{4}$ inches from mid-sternum. Action a little excited, but regular. On auscultation, in every area a simple cantering triple sound is heard, consisting of a first sound systole, as long as the other two together, and rather hard in character. The second and third sounds are apparently diastolic in rythm. No distinct bruit anywhere.

CASE 17.

Physical signs of fluid in chest—Serum drawn off on exploration. Negative result on attempted tapping four days later.

Martha Hinchliffe, ætat. 47. Admitted 7th December, 1881. Disch. 26th December, 1881, at own request.

In May, of the present year, three weeks after confinement, she was at work at the mill, standing in a

draughty room. She caught cold on the first or second day, experiencing pain in her right side on taking breath. She remained at work for a week, but the pain became so severe that she was obliged to desist and take to her bed. She remained in bed three months, having medical attendance. Tapping was advised but the patient refused. Cough came on with expectoration of heavy dark coloured sputa. No blood in sputa. At the end of three months she got up, feeling tired of lying in bed, though the symptoms were not improved. Since this time she appears to have got neither better nor worse. The pain is still present in the right side. She was not worse when she decided to enter the Infirmary.

December 9.—*Present condition.*—The patient is a well nourished woman, lying comfortably in bed in the horizontal position. Says she has lost four stones in weight since May. She is pale in the face, but says she had a deal of colour before her illness; lips good colour, no lividity, no movements *alæ nasi*. Breathing rather hurried, 22 per minute and of a heaving character. She says she cannot walk any distance, or up a few steps without having to gasp for breath.

Chest well proportioned. There is an almost absolute fixation of the right half on inspiration. She is most comfortable when lying on her back. She can lie on her left side, but cannot lie on right side at all on account of distress in breathing, and cough. On percussion, the whole of the right chest gives a leaden note, even to the supraspinous fossa behind. On auscultation little or nothing can be heard on the right side; vocal resonance increased, but there is no vocal fremitus. Left chest normal.

Heart.—The area of cardiac dulness is in its proper position and not increased. The apex impulse cannot be felt, sounds clear but feeble, first sound weak and sharp. Pulse small and compressible. Appetite very poor. Bowels regular.

Urine rather high coloured, sp. gr. 1020. No albumen. Right chest explored. Serum drawn off.

December 13.—Right chest tapped with Roberts' trocar with negative result. No fluid could be obtained.

December 19.—There is still marked dulness in whole of right chest, but more marked at apex than elsewhere. Vocal fremitus absent at right base.

CASE 18.

Right pleural effusion—Mitral bruit—Paracentesis—Relief.

Elizabeth Poole, ætat. 16. Admitted 5th October, 1881.
Discharged 15th October, 1881. Relieved.

Three weeks ago she awoke in the morning with sore throat, pain on swallowing, headache and pain across the loins, felt so ill that she returned to bed, and has been confined there since. There have been no rigors at any time during illness. She became gradually worse, was attended by a doctor who said she had inflammation of the lungs. Her chief symptom seems to have been shortness of breath; no cough, expectoration nor diarrhœa. No pain in side. Has been gradually improving for last week, except for shortness of breath, which is always worst at night and seems to come on as follows:—She falls asleep, perhaps comfortably, but is awakened in an hour or two by sudden dyspnœa. Has to sit up in bed and hold herself steady, can hardly speak. Attack lasts till early morning and then gradually passes away. She has not slept much since invasion of illness.

On admission—A pale looking, rather thin, sallow complexioned girl. Sits propped up in bed. Lips red. There is marked dyspnœa on any exertion.

Chest—Formation fair, but there is flattening at right apex. Expansion moderate and apparently equal. Percussion note fair and about equal on two sides; but there is dulness in front on right side from 3rd interspace downwards, and same

in axilla. At back also dulness is absolute, from about middle of scapula downwards. Vocal fremitus is good above dull area, lost below it. The auscultatory signs at right apex are puerile breathing, with prolonged expiration. Vocal resonance œgophonic. Below dull line, back and front, breath sounds are lost. Vocal resonance distant and feeble.

Left chest—Signs negative.

There is no crepitation ; nor night sweats.

Heart—Apex in fourth space $2\frac{1}{2}$ inches from mid-sternum. Sounds rather feeble. There is long blowing apex systolic murmur, feebly audible at apex, inaudible in axilla and at back. Second sound distinct but feeble and clear. *Pulse* 126, regular and compressible. There is no thrill over cardiac area. Was never short of breath until illness. No œdema of legs.

Abdomen—Negative.

Urine—Deep coloured. Clear. Sp. gr. 1010. No albumen.

October 8.—Hypodermic syringe introduced and withdrawn full of thin yellow opaque fluid.

October 7.—Aspiration of right chest in axilla about 8th space. Twenty-six fluid ounces of blood-stained thin fluid withdrawn by Roberts' trocar. Fluid sp. gr. 1020. Semi-solid with albumen. There did not appear to be much relief following the withdrawal of the fluid.

October 8.—Feels much better, the dyspnœa is lessened to a considerable degree, but Dr. Barrs considered that there was still more distress on movement than the condition of the chest would account for, although there were no signs of fluid at left base of lung, beyond impaired percussion note. A hypodermic syringe was introduced but no fluid found.

October 10.—Much better. No dyspnœa. Pulse 100, good. Respirations 34.

October 23.—Feels much better. Gets up in a morning without distress. There is well defined auriculo-systolic, and systolic bruit at cardiac apex. 2nd sound clear. Pulse 98, full, regular. No dyspnœa. No cough.

CASE 19.

Pleuritic effusion and ascites—Paracentesis thoracis—Albuminous expectoration—Paracentesis abdominis.

Tom Wray, ætat. 30. Joiner. Admitted 5th September, 1881. Discharged 9th November, 1881. *Worse.*

He was at work last on 25th May, 1881. Gave up work on account of illness, shortness of breath and abdominal pain. He had venereal sore eight years ago, not followed by constitutional symptoms. He was perfectly well up to beginning of May, 1881. Began to feel a lump rising in his throat when going up and downstairs, sufficient sometimes to stop his breathing and compelling him to rest. Six months before this strained himself while lifting some heavy planking, and had a little pain across the left chest. Felt nothing of it afterwards. Shortness of breath became constant at the end of May, and there has been cough throughout. Has never spat blood. Had jaundice 14 days ago. Five or six weeks ago a doctor told him that there was fluid in the right chest. Legs began to swell three weeks ago, and abdomen to enlarge about the same time. Has wasted. Flatulence prevents him from sleeping at night.

He is a moderately nourished, intelligent man; complexion sallow and unhealthy; conjunctivæ yellow. Now propped almost upright in bed; respirations, 40 per minute and shallow. Complains of flatulence and pains in body, but of no shortness of breath.

Chest of moderately good shape. Symmetrical. Tegument natural in appearance. No sinking or bulging of interspaces. Great want of expansion about lower part of right chest. On percussion, there is almost absolute soundlessness of whole

of right chest, except in parts above level of third rib in front, and behind in upper scapular region. The note behind is not so dull in paravertebral region as in more external parts. Axilla and other parts quite dull. On auscultation of right chest in subclavicular region, there is exaggerated breathing with increased resonance of voice, but no adventitious sounds. In dull areas, there is more or less absence of breath and voice sounds. No opening of percussion note at right apex.

Left lung negative.

Heart.—Impulse feeble and indistinct. Action rapid, but regular. Apex beat not located with certainty. There is an impulse in fifth space of indefinite character, which might be it, five inches from middle line. Sounds clear.

Abdomen.—Globular and symmetrical. Distended and resonant about umbilicus. Dull in flanks. Fluid easily made to traverse abdomen. On rather forcible dipping in right abdomen the liver can be felt smooth and hard. Spleen not felt.

Legs are moderately œdematous.

Urine high coloured. Clear. Sp. gr. 1022. No albumen.

September 13.—Right chest tapped yesterday with Roberts' trocar. Fluid drawn rather rapidly. Had to stop at 58 fluid ounces, on account of distress of breathing. Almost immediately after tapping, he began to cough up a fluid identical with pleuritic effusion; and during last 22 hours has brought up in this manner nearly two pints of fluid. Says he has been much relieved by tapping.

September 14.—Still spitting up blood, but in much less quantity. Only an ounce or so during the last 24 hours. Fluid spat up yesterday, after masses of mucus had been removed by filtering,

presents exactly same appearance as that drawn from chest. It is loaded with albumen and gives some indication, with nitric acid, of presence of bile pigments.

September 28.—Distinct pleuritic friction sound above liver.

October 1.—Paracentesis abdominis to 98 fluid ounces.

„ 25.—Right chest tapped again yesterday. eight ounces of clear serum drawn off. He seems much relieved by the operation.

October 28.—Paracentesis abdominis to 188 fluid ounces ordinary ascitic fluid.

Urine.—A persistent continuous state of high-coloured non-albuminous urine, loaded with lithates.

CASE 20.

Pleural effusion. Fluid drawn on exploration. First tapping barren; afterwards satisfactory.

William Flint, ætat. 58, labourer, admitted 17th January, 1881. Discharged 11th March, 1881.
Relieved.

Twelve weeks ago he awoke in the night, on account of shortness of breath, which had come on suddenly. There was only slight pain in left chest. There was not much cough; but little expectoration, occasionally streaked with blood. Has wasted considerably since onset.

Chest.—(Curtailed notes). Almost absolute dulness of lower half of left chest in posterior and lateral regions, with total absence of breath sounds over dull area. Apex of left lung resonant, and air can be heard to enter it freely: no change in breath or voice sounds at left apex. Temperature never above 100°

January 28.—Explored chest, with Dr. Eddison; a little brownish clear fluid drawn off from about left eighth space.

January 31.—Aspiration at seat of exploration, and at another point failed to obtain fluid.

February 4.—Aspiration; 220c.c. of fluid drawn off.
Fluid—Thin, opaque, dark reddish brown colour
Microscope shews abundant red blood cells.

CASE 21.

Hydatid of lung—Aspiration.

Maria O'Donnell, ætat. 19, Millhand, admitted
3rd January, 1881. Discharged 9th April. 1881.
Much relieved.

She was in the hospital from August 30th to November 13th, 1880, when the suspicion of hydatids was aroused, but not confirmed. On September 16th, 1880, Dr. Eddison discovered a membranous mass in the spittoon, and it was concluded that it could be no other than hydatid cyst wall. No hooklets could be found on the most careful searching.

There was then dulness in upper part of left chest. Cough and hæmoptysis were the distressing symptoms. Pyrexia also.

February 13.—*Chest*.—Still symmetrical, but marked want of movement in upper left side. The upper half almost of left chest, both back and front, seems now to be involved. It is impossible to separate cardiac area. On percussion there is absolute dulness from extreme apex to lower limit of cardiac area. The note differs in the upper and lower (cardiac) part of this area. In the upper it is short, very high-pitched and slightly amphoric in character; in the lower it does not differ much from the ordinary dull cardiac note. The dulness in axilla is not so marked as formerly, though still present. The dulness behind practically corresponds to scapular region. On auscultation, ordinary breath sounds are replaced by fine high-pitched tubular breathing, somewhat distant, but specially marked in character, in third space in parasternal line. (It is clear that there is much diminished quantity

of air entering left upper lobe). The voice is near, intensified, and slightly œgophonic in character. Vocal fremitus (voice high-pitched) does not differ much from opposite side, it is practically absent on both sides.

Right lung—Wholly negative.

February 16.—Aspiration of dulness, with fine needle through third space in axillary line. Fluid at once escaped, drawn slowly and without full pressure. Very little pain or discomfort during operation, till full twenty fluid ounces had been withdrawn, when uncontrollable coughing, with some hæmoptysis, set in. Needle at once removed. The coughing continued of a most distressing character, with tolerably free spitting of blood and mucus, soon followed by watery fluid in considerable quantity. Morphia, gr. $\frac{1}{4}$ subcutaneously, relieved cough for a time, but produced troublesome vomiting, and increase of hæmorrhage.

February 17.—Little change in physical signs, save that air is now entering left apex. No dulness nor moist sounds at left base.

February 19.—Severe cough, with free profuse bloody expectoration. R. 64. Pulse 130, very feeble, and beats running into each other.

April 7.—There has been steady improvement since last note. Now spitting about ten or a dozen pellets of blood-stained mucus in 24 hours. General condition, still improving. Left chest now absolutely dull, from clavicle to third space from mid-sternum to border of axilla (anterior). Over this dull area loud tubular breathing, with pectoriloquy, heard. In axilla, resonance fair, with indeterminate breathing. Over scapular region, percussion note resonant, but much impaired; still of good character. There is very good expansion of upper left chest.

CASE 22.

*Sero-purulent Effusion—Aspiration—Empyema Formed—
Thoracentesis—Death.*

Patrick Rowley, ætat. 40, Plasterer, admitted
August 18, 1883.

Family History.—Unimportant, beyond the fact that he thinks an uncle was “touched” with phthisis, but does not know definitely.

He has been a heavy beer drinker, but taken no spirits.

Some years ago had an illness of four weeks’ duration. Does not know its nature, but it was some chest affection. Has ailed from time to time, sometimes having to give up work, but without consulting any doctor. Has always had a bad appetite, sometimes going a day or two, practically without food, bringing it home again from his work.

Married. Two children living, three dead, two still-born.

Present illness began three weeks ago, up to which time he had been fairly well. Was seized, while washing himself, with sharp pain in right side, about lower end of sternum in perpendicular nipple line, which took his breath and prevented free coughing, which came on simultaneously. He perspired freely. Went to bed in great distress, propped up, and has never been able to bear supine position since. He spat up phlegm of thin mucous character, but no blood. Felt very ill. Was taken to Union Hospital of Leeds, and got no relief until Dr. Crooke aspirated the right chest, and drew off a pint of sero-pus. This gave him immediate relief from pain and dyspnœa, and he got up next day without discomfort. Improved until admission here, on 18th August, 1881, six days after aspiration.

On admission, colour good in both cheeks and lips. Frame very thin. Says he had been losing flesh for some time before illness, along with insufficient food.

Has had a cough for three or four years, and night sweats for a long time. No hæmoptysis. Sits up in bed in comfort; breathing easy and free. Only complains of pain in right side on exertion. Appetite fair; tongue, coated and moist. No diarrhœa. Cough worse at night, but not severe. Cannot lie on either side for pain. Fingers a little clubbed, but not typical. Irritable papular eruption on arms and thighs, apparently from scratching.

Physical signs.—Chest wall flat and thin. Considerable prominence of second rib on both sides, giving appearance of marked depression at apices. Expansion good on left side; a little impaired in right lower chest. Inspection shows a normal perpendicular chest wall on left side, but bulged out on lower part of right side. Percussion gives deficient (boxy?) resonance over upper right chest in front. Breath-sounds audible, but poor. Breath-sounds absent in lower third of right chest, where there is complete dulness.

Behind.—Impaired percussion note and breath-sounds over upper two-thirds on right side, with amphoric breathing. Lower third dull; no breathing audible. Succussion gives splash at base on right side.

August 20, 5 p.m.—Mr. Brown, House-surgeon, made an opening under ether and carbolic spray, between ninth and tenth spaces, on outer side of right chest. Forty fluid ounces of sero-pus were evacuated and much air (sweet). A double drainage tube was inserted, and antiseptic dressings applied.

Temperature.—Evening—Normal. Two hours afterwards was very comfortable. Colour good. No dyspnœa. At 11 p.m., general aching all over right chest, and some dyspnœa. Orthopnœa marked. Ordered Spt. Æther Sulph. Co., 3ss. secundis horis during night.

August 21.—Feels well. Pulse 78. Breathing quiet. Temperature normal. There has been free discharge during night.

August 22.—Present condition of chest.—There is boxy percussion note over upper part of right chest above the dressings. Breath sounds only represented at apex by a few râles of fine character. In third interspace, breathing audible and amphoric. Left side—There is dulness at inner side of left apex for two inches with ægophony; some coarse moist sounds, harsh breathing, and prolonged expiration. Percussion note good in third space outside cardiac area.

Heart.—Apex difficult to localise, owing to dressings. Not displaced outwards. No bruit.

Urine normal.

August 23.—Pulse 140. Great dyspnœa; worse at night. Temperature rising straight up without any morning remission. Dressing daily to chest.

August 24.—Cyanotic. Cold sweats. Pulse very feeble. Rallied with brandy. Died during night.

CASE 23.

Pleuritic effusion—Paracentesis twice—Cure.

Richard Horn. ætat. 34. Miner. Admitted 23rd November, 1881. Discharged 26th December, 1881.—*Well*.

Illness commenced 9th of May, 1881, with cold shivers, cough, shortness of breath, some pain in lower left chest and a little expectoration. He saw a doctor, who said it was consumption and weakness. Went into B—— Hospital on 16th. Was in Hospital nine weeks, and had the chest plaistered there. Bronchitis set in when in Hospital. He has wasted a little during the last seven days, and now complains of shortness of breath, especially on exertion, so that latterly he has been unable to go more than 10 or 15 yards at once. Occasional attacks of rather dangerous dyspnœa.

Present condition—A not unhealthy looking man. Now sitting up in bed without any obvious distress. Pupils moderately dilated. Lips a little blue. On close inspection, the breathing is found to be hurried. He can lie in almost complete horizontal posture with only a little distress. Lies on right side, by preference. Not seriously wasted.

Chest of good shape and capacity. No want of symmetry unless it be from squaring of right side. The right interspaces are not so easily felt, perhaps, as the left, but there is no distinct bulging. Tegument of chest natural. There is great want of expansion, with feeling of solidity about the right chest. Measurements over nipple—Right chest $18\frac{1}{4}$ inches; Left chest 17 inches.

On Percussion there is absolute soundlessness of whole of right chest from apex to base, with the exception of slight very high-pitched semi-amphoric resonance below right clavicle. The dulness does not cross the middle line.

On Auscultation at right apex, almost cavernous breathing is heard of a clear character, with an occasional mucous râle. Sounds in other parts negative—absence of breath and voice sounds. Total absence of vocal fremitus.

Left chest—Percussion note normal. Breathing, a little exaggerated, but otherwise, the left lung is clear.

Heart.—Evidence of considerable displacement. Apex beating visibly in 5th space, six inches from middle line and three inches outside nipple. Sounds clear. Pulse 104. Respirations 28 per minute. Urine high coloured, sp. gr. 1020. No albumen. Chlorides abundant.

November 25.—Right chest tapped with Roberts' trocar. Only 17 ounces of fluid drawn off. Unsatisfactory operation. Canula could not be kept in pleural cavity.

November 27.—Right chest tapped with Roberts' trocar. Eighty ounces straw-coloured serum drawn off.

November 28.—Right chest, very little movement. Area of non-dulness in front increased downwards, otherwise, no material change in condition of chest. Heart's apex now beats in 4th space, $3\frac{1}{2}$ inches from middle line. Respirations 28 per minute.

December 12.—Chest again tapped. Seventy ounces of fluid, of same character as before, drawn off. Resonance (rather low pitched note) has returned in all parts of right chest.

December 14.—There is resonance on percussion over the whole of right chest. Vocal fremitus and resonance present.

CASE 24.

Pleural Effusion—Paracentesis three times—Tuberculosis—Death.

Wm. Wormald, ætat. 43, Smith, admitted
Sept. 9, 1881; Died Nov. 7, 1881.

Illness commenced gradually, five months ago, with ordinary "cold" and some shortness of breath. There has been dyspnœa, brought on by least exertion, and worse when in bed. Ten weeks ago was seen by Dr. Clifford Allbutt in consultation, when left chest was explored, with negative result; exploration repeated one month afterwards, with same result. There has been night fever, with rambling and much wasting.

He is now sitting quite upright in bed, breathing rapidly, and with some difficulty. Respiration of slightly ascending and descending character. Face rather pale; no lividity. No engorgement of superficial veins. Pupils equal, not dilated. Fingers not clubbed, and not blue.

Chest.—There is almost absolute fixity of whole of left chest. What little movement there is, is not the result of genuine expansion, but of dragging from opposite side. No bulging of intercostal spaces.

On Percussion, there is absolute soundlessness of whole of left chest, without exception.

Auscultation.—On left side, entirely negative. Voice audible, but much impaired. *Fremitus* absent throughout.

Physical examination of right lung negative. No morbid signs. Radial pulses equal—124. Respirations 36.

September 12.—Left chest tapped yesterday. Fifty ounces of fluid drawn off. A little cough and distress towards latter part of process, necessitating withdrawal of canula while stream was still flowing. Some pain in chest during the night. There was fairly satisfactory improvement in symptoms almost immediately after operation. This morning he is lying much lower in the bed. Respirations, 36.

Chest.—Some return (obvious to patient himself) of resonance at left apex, with harsh breathing and increased vocal resonance. Some little expansion of left apex.

September 13.—Respirations, 32. P., 134. Sep. 14. R., 28. P., 104.

September 17.—Chest again tapped yesterday. Twenty-three ounces of fluid drawn off. Respirations, 24. Pulse, 104.

September 19.—Decided improvement in condition of left chest. There is now appreciable movement in left chest, as low as fifth rib in front. The movement is not great, but still sufficient to show that air is entering upper part of left lung. Over the same area, there is some return of resonance, with loud bronchial breath-sounds and increased vocal resonance. The patient looks better. Pulse, 112.

September 27.—Left chest tapped again. Twenty ounces of fluid drawn off.

October 1.—Changes in left chest more marked. Vocal *fremitus* perceptible all over posterior aspect. Breath-sounds at left apex more distinct. General condition about the same; not improving much.

October 11.—Fremitus easily felt all over left chest. Slight breath-sounds audible. A little improvement in general condition.

October 14.—Still an almost iron fixity of left chest.

„ 27.—Left chest again explored behind, with negative result.

October 30.—Left chest again explored; in lateral aspect. Small quantity of blood stained fluid drawn off with difficulty.

There was then rapid wasting, and patient died on November 7th. On *post-mortem* examination, general tuberculosis.

CASE 25.

Latent Pleuritic Effusion—Paracentesis Thoracis—Cure.

Polly Hall, ætat. 41, admitted 16th July, 1881.

Discharged 6th August, 1881. Well.

She has not been well since her confinement, six weeks ago. Three weeks ago was obliged to take to bed from languor and weakness, and three days ago had violent shivering. No severe pain. During last three weeks she had always lain on the left side, until last day or two when she has found it more comfortable to lie on the right side.

Present condition.—Does not appear to be suffering from any acute illness, and rests comfortably in bed on the back or right side. Breathing tranquil, 28. Pulse 100 per minute.

Chest.—Expansion good and apparently equal. On left side there is almost absolute dulness from clavicle downwards; breath sounds at apex being very indistinct and whiffing. Vocal resonance slightly diminished.

Right lung—Breathing a little pronounced, otherwise negative.

Behind—Left lung, expansion decidedly wanting, and from apex downwards there is complete

dulness, and absence of breath sounds. Vocal resonance is œgophonic, and fremitus wanting. Right lung negative.

Heart's apex beats to right of ensiform cartilage, midway between it and costal cartilages. No murmur.

Urine.—Sp. gr. 1008. No albumen.

Paracentesis thoracis — Forty-two fluid ounces opaque straw-coloured fluid removed, containing albumen. No microscopic elements. *Heart's* apex is now felt in fifth space, one inch to left of mid-sternum; dulness in left lung almost as marked as before, but breathing, of tubular character, can be heard in upper part of left lung, behind. Patient feels much relieved by operation.

July 21.—There is resonance in front of left lung, though not so good as on right side.

Behind, dulness is well marked, except in upper part, where note is not so absolutely wanting. Breath-sounds are audible as low as angle of scapula.

August 3.—There is deficient percussion note on left side at apex, by comparison. Vocal resonance equal on two sides. Percussion not good in axillary line and behind. Vocal fremitus equal, but breath sounds not so marked at left base as the right. No œgophony. No cough.

CASE 26.

Pleuritic effusion—Expectant treatment—Cure.

Geo. Silson, ætat. 11, admitted June 16th, 1880.
Discharged July 12th, 1880. Well.

He is said to have been ill a month, but was at school three days ago. He is a healthy-looking, well nourished boy, complaining of pain in left chest and shortness of breath.

Thorax.—Large and square. Deep from before backwards. Symmetrical. Measurements at nipple level, right side 13 inches, left side $12\frac{3}{4}$ inches. Expansion much impaired on left side, but good on right. On left side there is almost absolute dulness in front, from the clavicle down to the 5th rib or thereabouts. The lower limit of dulness runs obliquely downwards and backwards, through left lateral aspect of chest to lower limit of lung behind. Below this, there is the tympanitic note of distended stomach. Percussion note on right side fairly good. On auscultation on left side, faint breath sounds are heard in front, accompanied by slight ægophonic voice resonance. Behind, on left side, there is absolute dulness from apex to base. Breath sounds, much impaired, are heard for a little distance outwards from spine. In axillary line breath sounds are inaudible. Tactile fremitus absent on left, present on right side.

Heart.—Impulse not felt in normal site, most marked in epigastric notch. Apex beat not found. Over usual site of apex, systole is heard scarcely pure. At base, on left of sternum, distinct reduplication and accentuation of 2nd sound, perhaps most distinct in pulmonary area. There is rapid undulatory movement in vessels at root of neck, (probably venous) the exact relation of which, to cardiac contraction, cannot be made out.

Urine pale, sp. gr. 1005. No albumen. No sugar.

June 21.—Dulness in left chest now reaches only to level of 2nd rib.

June 23.—Left chest now resonant in every part, but much less so than the right.

July 1.—Dulness in left chest almost entirely gone.

July 8.—Second cardiac sound still reduplicated. Heart's apex seen beating in 5th space, 2 inches from mid-sternum.

July 12.—Discharged—Well. Treatment—*Nil*.

CASE 26A.

Latent pleural effusion—Paracentesis—Cure.

Thomas Maloney, ætat. 26, labourer, admitted 29th April, 1880. Discharged 15th May, 1880. Well.

Nineteen days ago illness commenced, while he was working in the rain, with pain in the right side of the chest, followed in two days by cough and shortness of breath.

Is a well nourished man, rather pale. Breathing short, 32 per minute.

Thorax well formed. Intercostal depression invisible on right side, marked on left. Expansion impaired on right side, but present. Measurement of two sides at nipple level same; $18\frac{1}{2}$ inches.

On percussion, there is not a single spot of resonance in whole of right chest, even in the supra-clavicular fossa. The auscultatory signs are purely negative, nothing can be heard except a little indefinite noise towards root of lung. Vocal resonance and fremitus entirely gone. Left chest negative beyond loud breathing.

Heart.—Much displaced. Apex beats distinctly in sixth left space, $5\frac{1}{2}$ inches from middle line, and $1\frac{1}{2}$ inches outside nipple line. Sounds not clear. First sound at apex impure. Second sound at base reduplicated.

Liver not felt. Spleen not enlarged.

May 3.—Right chest tapped with Roberts' trocar in about 8th space; 157 fluid ounces of straw coloured serum, of the ordinary pleuritic character, drawn off.

May 4.—Much relieved.

Thorax.—There is now high-pitched resonance over whole of right lung from apex to base. Breath sounds, vocal resonance and fremitus everywhere audible.

Heart.—Apex beats in sixth space, three inches from middle line. Sounds clear, and reduplication at base of second sound entirely disappeared.

A coarse pleuritic friction-sound is perceptible to hand, and audible over front of right chest.

May 10.—There is now impaired resonance over right lung, behind, with some signs of refilling.

May 12.—There is very high-pitched resonance (not absolutely dull) over right lung, behind. Air can be heard to enter every part of the lung. Vocal fremitus a little increased, if anything. Heart's apex beats softly in the sixth space, $3\frac{1}{2}$ inches from middle line. Sounds clear.

Treatment.—*Nil*.

CASE 27.

Sero-purulent Effusion—Paracentesis—Empyema—Paracentesis Repeated.—Death.

James Fullan, ætat. 54, labourer, admitted 21st July, 1880. Died August 8th, 1880.

No history of case given.

July 31.—*Chest*.—Rather small, and inclined to the barrel-shape. In front, bulging above the nipple, and anterior intercostal spaces obliterated on the right side. Expansion on right side very deficient, but most marked at apex. Visible cardiac impulse in fifth interspace, directly below the nipple.

In front—On percussion, the whole of the right side from above the clavicle to the base gives a dull note. Breath sounds, excepting those conducted from the bronchi or trachea by chest walls, are inaudible, and vocal thrill is almost gone.

On the left side, the percussion note is all over somewhat intensified and hyper-resonant. Thrill well marked, and there are no râles with breathing. Inspiration is slow, and the interval between it and expiration prolonged, expiration being sudden and short.

Behind, there is complete dulness, except in the supra-spinous fossa, where metallic bronchial breath-sounds are heard on the right side. Vocal resonance present; but distant.

The heart's apex beats at the margin of the left axilla, in the sixth interspace. First sound thick, but there is no bruit. Pulse, 112. Respirations, 28 per minute.

Paracentesis thoracis. One pint of turbid serum withdrawn.

August 2.—Breath sounds audible as low as the angle of the scapula on the right side, and above this point the surface is resonant. There are whistling râles on expiration. Pulse, 100. Respirations, 20.

August 7.—Chest aspirated. Six pints and eight fluid ounces of very foetid fluid withdrawn. Patient evidently sinking.

August 8.—Patient died.

CASE 28.

Pleuritic Effusion—Paracentesis—Cure.

Edward Fortune, ætat. 41, Carter; admitted April 6, 1880; discharged April 27, 1880. Well.

Illness commenced a week ago, with cold and shivering. No pain in chest nor cough. Has wasted, and had shortness of breath three weeks.

Thorax well formed. Expansion fair, but more on right than left side. Perhaps the intercostal spaces are a little more marked on the right side. Supra-clavicular fossa not altered.

On percussion, there is absolute dulness in all parts of left chest, except the supra-clavicular fossa, where there is resonance of an impure character. There is almost an entire absence of all sounds whatever in left chest, except near middle line, both behind and in front. Right lung is healthy. The heart's impulse cannot be localised, but seems to be displaced somewhat to right. Sounds clear.

Urine.—Sp. gr. 1025. No albumen; no sugar; chlorides abundant.

April 12.—Left chest tapped with Roberts' trocar; 128 fluid ounces of fluid drawn off.

April 13.—Much relieved. There is now some return of resonance at apex on left side; but the note is still dull, and little sound can be heard with the stethoscope. Behind, there is still absolute dulness above angle of scapula; but below this there is almost tympanitic resonance. The vocal fremitus is increased over whole of posterior surface of left lung. Nothing heard, except loud pleuritic creakings at left base.

April 27.—Still marked signs of fluid in left chest. General condition much improved.

May 1.—Left chest resonant, but slightly less so than right. Air can be heard to enter lung in every part, but near spine, accompanied by loud pleuritic creakings. Fremitus and vocal resonance good. Comparative dulness at left apex, with no other sign.

CASE 29.

Pleuritic Effusion—Paracentesis—Relief.

Thomas Young, aged 28, Labourer.

(Curtailed notes).

The patient was admitted under care of Dr. Eddison, and discharged relieved.

Sixty-eight ounces of pleuritic serous fluid were drawn away. The fluid had a specific gravity, 1020, and was loaded with albumen. The day after the aspiration there was still dulness on percussion, over the area which was noted as dull before the fluid was drawn away, although some distant breath sounds, not before present, were noted. Three days after the operation, it was observed that the dulness was increasing, and on that day he left the hospital.

CASE 30.

Pleuritic Effusion—Expectant Treatment—Almost well.

Daniel Tanner, ætat. 16, Labourer, admitted
January 26th, 1880. Discharged February
28th, 1880.

Family History.—Father died of bronchitis and inflammation of the lungs. Mother living. Some brothers and sisters died in infancy.

He has had measles, and been a labourer four years. He worked up to three days before admission.

Present History.—Was quite well up to six weeks ago, when he was seized with sharp pain in the right chest, accompanied by painful cough, with some expectoration (no blood). Pain continued severe for two days, and then disappeared; the shortness of breath also diminishing. Cough has persisted throughout. Has slept on right side, and prefers doing so, rather than on the left, but generally lies on the back. He has wasted during the illness, but breathing is not so "short" as it was. Came to out-patient room yesterday, complaining of cough and wasting.

He is a fairly nourished lad; face covered with freckles. Eyes bright, pupils normal. No lividity of lips or cheek. Lies always by preference on the back.

Thorax.—Well formed. Movements of right side a little impaired, and the percussion note at right apex increased. There is absolute dulness in lower part of right chest, from level of fourth rib, behind and in front downwards, with much impaired breath and voice sounds. Above dull area there is loud breathing, but no increase of voice. Left chest normal. Heart's apex in fifth space $2\frac{3}{4}$ inches from mid-sternum.

February 6.—Weight, 5st. 10lb.

„ 16.—Weight, 6st. 0lb.

There is some comparative want of resonance in right chest, from spine of scapula, downwards, but no absolute dulness till about the level of the

eighth rib. Only over the absolutely dull area are the breath sounds and vocal resonance impaired, and vocal fremitus lost.

February 23.—Absolute dulness at right base well defined; upper limit at or about tenth rib. Other signs of fluid well marked.

February 28.—Patient left Hospital at own request, some fluid still remaining.

Treatment—

Ordinary diet.

Mist. Ferri Perchlor: one ounce three times a day.

CASE 31.

*Fibrino-serous effusion with œdema of chest wall—Paracentesis.
Cure.*

Edwd. Reader Hall, ætat. 52, cordwainer, admitted
28th June, 1880. Discharged 3rd September,
1880. Well.

June 29.—Family history unimportant.

For two years he has been losing flesh, and for three months has had a cough, with expectoration. Has been a teetotaler for 25 years.

A month ago he was quite well and working, and when at work a fortnight ago, was taken ill with shivering, vomiting and severe frontal headache. He has done a little work until two days ago, and has not kept his bed. Cough has been worse, but there has been no rusty coloured nor blood-stained sputa, which was usually yellow. No diarrhœa nor night sweats until a week ago.

He is a thin, sallow, unhealthy looking man. Conjunctivæ yellow. Subcutaneous fat deficient. He sits up in bed but can lie down, although the former is the easier position. Lies on back better than on either side, and better on the right than on the left side. No pain when at rest.

Surface of body marked by bites of insects. Left side of chest quite dull, except at apex in front, where

there is a little diminution in amount of dulness over clavicle. Breath-sounds altogether gone, but there is an occasional "rub" above. Vocal resonance muffled, fairly loud, not increased nor œgophonic. Thrill absent. Breath-sounds audible all over right side of chest, whistling rhonchi and râles accompanying them. Apex resonance as good as elsewhere. *Left chest wall œdematous*. Troublesome short cough, with expectoration of clear, liquid, white, frothy mucus. Heart's apex cannot be found nor seen. Distinct epigastric pulsation, and first cardiac sound loudest at ensiform cartilage; no bruit.

Respirations, 32 per minute. Almost entirely carried on by right side of chest. Pulse, 112; regular, small. No œdema of feet.

Urine—Sp. gr. 1012. No albumen.

Aspiration in tenth space in axillary line, shows that pleura contains clear serum.

July 1.—Left chest tapped with Roberts' trocar in axillary line, in sixth space; 90 ounces of clear straw-coloured serum drawn off.

July 3.—Left chest is now resonant behind, but dull, in comparison with opposite side. Heart's apex beat cannot be found. Respirations, 32 per minute.

August 2.—The percussion note on the left side in front is clear and resonant; and, on auscultation, breath-sounds less distinct than on the opposite side, and accompanied by rhonchi, are heard.

Behind there is no dulness; but at the left base there is impaired resonance, with increased resistance. The breath-sounds are audible all over, loudest above, but not so loud as on the opposite side. Respirations, 28 per minute. He still coughs.

CASE 32.

Pleuritic Effusion—Paracentesis—Cure.

John Carroll, ætat. 17 ; admitted, February 23, 1880 ; discharged April 14, 1880.

Says he has been ill only three days. He is a healthy-looking well-nourished lad, lying on his back. Breathing rapid, but not laboured.

Absolute dulness of right chest, from angle of scapula downwards. Voice œgophonic, and breath-sounds impaired. Left lung clear. In front, the percussion note at the right apex is decidedly tympanitic, and the voice sounds increased. Heart's apex beats in fifth space, $3\frac{1}{2}$ inches from mid-sternum.

February 25.—Tympanitic note at right apex much more marked. Absolute dulness, from angle of scapula downwards. Voice sounds audible, but feeble, and slightly œgophonic in character.

March 1.—Movement of right chest much impaired, especially at lower part, where ribs are absolutely motionless. Lies on right side by preference. Respirations, 48 per minute. On percussion in front, the note at the right apex is found to have undergone a marked change, being now of high-pitched amphoric character. Breath-sounds, loud, short, and bronchial ; voice, bronchophonic.

Behind, there is absolute dulness, from a hand's breadth below the line of the shoulder to the extreme base. Breath-sounds entirely absent. Voice absent in lateral parts, and is œgophonic towards spine. Heart's apex beats in fifth space, $3\frac{1}{2}$ inches from mid-sternum in nipple line.

Urine.—Sp. gr. 1025. No albumen. Chlorides abundant.

Right chest tapped with Roberts' trocar ; 40 ounces of brownish yellow fluid drawn off. Under microscope, fluid shows numerous altered leucocytes.

March 2.—Feels better. Respirations 40 per minute. The only obvious change in the physical signs is a marked alteration of the percussion note at the right apex, which has now lost the marked amphoric character noted before tapping, but still remains of somewhat tympanitic character. The vocal resonance at the right apex is still increased in front, whereas behind, it has recovered a little of its œgophonic character.

March 8.—The physical signs remain unaltered.

„ 20.—Percussion note at right apex a little higher pitched than left. Below, the dulness is diminishing, its upper limit being the mid-scapular region. Fremitus nowhere entirely absent, and vocal resonance is now heard impaired at the extreme base. Has got up daily since the 16th inst.

March 30.—No absolute dulness in right chest, and fremitus is returning. Breath sounds on right side are much impaired.

April 11.—Still a little comparative dulness at right base.

Treatment—*Nil*.

CASE 33.

Pleural effusion—Expectant treatment—Cure.

Wm. Whittaker, ætat. 18, file cutter, admitted April 2nd, 1880. Discharged April 27th, 1880. Cured.

History extends over five weeks, and he commenced with sharp pain and febrile disturbance.

He is a pale, unhealthy looking lad, with blue lips. Sits propped up in bed. Lies by preference on the right side. There is no pain at present, but frequent cough with little frothy expectoration, and shortness of breath on the slightest exertion.

Chest.—Dulness on the right side below the 8th dorsal spine, and when this was explored with the syringe, clear serum was withdrawn.

Treatment—April 5th. Mist Digitalis : one ounce thrice daily.

„ 14th. Mist. Ferri Perchlor : one ounce thrice daily.

CASE 34.

Pleuritic Effusion—Paracentesis twice—Relieved.

George Burnside, ætat. 56, Labourer.

June 19th, 1879.—He has been ill nine months, and was in bed for six weeks, in October and November, 1878, with pleurisy. Has worked “on and off” up to 14 days ago. Complains of shortness of breath, pains in the back, wasting, and cough, with expectoration. No hæmoptysis. He is an aged, worn-looking man, somewhat wasted. Lies easily in any position, except on the left side.

Thorax.—Bulged anteriorly. Enfeebled expansion, left side. No œdema of chest wall, nor bulging of intercostal spaces. Left chest is almost absolutely dull, both in front and behind, but the dulness does not extend so high behind as in front.

On auscultation—In front, little or no breath-sounds can be heard; the voice is almost absent, and tactile fremitus gone.

Behind—No breath nor voice sounds heard. Fremitus absent.

July 18.—Dulness from second rib downwards. Chest tapped, and 24 fluid ounces of serum withdrawn.

July 19.—Breathing can now be heard all over the left lung, in front and behind; not so distinctly at the base, where it is decidedly bronchial. Above, the breathing is a little coarse, but there are no adventitious sounds. Resonance much better than yesterday.

July 23.—Physical condition same as before tapping.

Re-admitted February 2, 1880.

At present complains of pain in left side, at lower part of chest. Is short of breath and coughs, expectorating very little. Has lost flesh since he was in hospital before; face pale and somewhat sallow, lips natural. Easiest position is on right side. Appetite, good. Tongue, fissured and coated. Bowels open.

Urine.—Acid sp. gr. 1030, no albumen nor sugar; full of lithates.

There is absolute dulness in left chest behind, from angle of scapula downwards, with impaired voice and breath-sounds, and also want of vocal fremitus.

February 4.—Left chest tapped with Roberts' trocar, and 21 ounces of straw-coloured serum withdrawn.

February 6.—Dulness has diminished only a little, and the vocal thrill can just be felt at the left base, but only very little indeed.

February 12.—Dulness clearing. Still absolute at base. Patient has been in hospital twice before.

February 19.—Left hospital, some dulness remaining.

CASE 35.

Pleuritic effusion—Paracentesis—Relieved.

Walter Woodall, ætat. 17, groom.

1879.

December 8.—He was quite well thirteen days ago, when he began to feel chilly and generally unwell. No definite symptoms. Seven days ago, though still far from well, he walked eight miles, and the same the following day. There has been constipation throughout, the bowels acting only after purgatives. He has gone about the whole time and worked "on and off."

Pale, rather spare. Lips dry. Apathetic. Pupils dilated. Lies easily on back or either side. Tongue large, flabby, coated and not dry. Pulse, 120; regular, large, soft, feeble.

Urine, 1023. Very faint trace of albumen.

December 13.—Troublesome cough, which gives him considerable pain in the right iliac region. Lower three-fourths of left chest are dull on percussion behind, the breathing is bronchial and muffled. No crepitation. Voice-sounds impaired. *Fremitus* absent. The left chest in front also absolutely dull, and there is total absence of breath, and voice-sounds are diminished. The heart can be seen beating on right side of sternum in 3rd and 4th spaces. Absence of cardiac impulse and distinct sounds in normal area.

December 17.—Physical signs of fluid in left chest remain the same. Dulness absolute up to left clavicle in front and up to corresponding level behind. Voice and breath-sounds distant and indistinct. *Fremitus* absent. Heart still much displaced, the greatest cardiac impulse being felt to the right of sternum in 3rd and 4th interspaces. Respirations, 28 per minute. Chest tapped with Roberts' trocar in 8th space and 17 ounces of pellucid straw-coloured serum drawn off. During the operation, the heart could be distinctly felt to swing back to its normal position or nearly so. Percussion not materially altered.

December 18.—Better. Respirations, 20. Absolute dulness in front, commencing at third rib, and expansion is still much below that of the right side. Apex beats now in 5th left space, $2\frac{1}{4}$ inches from sternum.

December 22.—Unable still to lie on right side. The percussion note over left lung in front is steadily improving, and behind also, though still dull. Bowels open regularly, and the heart has recovered its natural position.

December 24.—Area of resonance over left lung is gradually increasing.

December 29.—Much better. The dulness in left chest now extends as high as angle of scapula behind, and the signs of fluid are still evident.

1880.

January 1.—General condition not much improved.

There is resonance over left lung in front, but of very unsatisfactory character, with bronchial breathing. No moist sounds. Fremitus and voice present. Dulness at back has almost entirely disappeared.

January 15.—Better. Marked changes in left chest.

There is considerable shrinking of left chest, in all its parts, with marked subclavicular flattening. The left ribs move little, if at all, on even deep inspiration. Left chest measures at level of nipple, 15 inches ; right, 16 inches.

The percussion note is everywhere impaired, though not absolutely dull till about seventh rib, whence to extreme base it is so. At the apex, and parts above seventh rib, there is resonance of a very high pitch, compared with opposite side. Over the dull area breath sounds are absent, or nearly so, the voice inaudible, and the vocal fremitus not felt. At apex, and over resonant parts, breath-sounds of a feeble, rather bronchial character are heard ; and the voice sounds and fremitus, though present, are much impaired, in comparison with opposite side.

The heart is still displaced to the right, the greatest impulse being felt in fifth space, immediately to left of edge of sternum (probably apex beat).

The general condition has improved, notwithstanding that the temperature has now assumed a hectic character. There is but little cough, with slight muco-purulent expectoration.

January 18.—Chest explored (left side eighth space).
Negative result.

January 26.—Weight, 9 stones.

„ 31.—There is not now absolute fixation of left chest, but the upper part moves little, if at all, what movement there is being confined to parts below the nipple. Flattening below the left

clavicle more marked than ever. Dulness now not absolute in any part of left chest, even at extreme base, but there is much impairment of resonance, everywhere marked by heightening and shortening of note. The note is best at the apex. Air can be heard to enter every part of lung, but the sounds are feeble and bronchial in character. Voice-sounds are impaired, rather than otherwise, especially at base. No moist sounds.

Weight—

	St.	Lb.		St.	Lb.
Feb. 2 ...	9 ...	5½	Mar. 2 ...	10 ...	0¼
„ 17 ...	9 ...	6½	„ 10 ...	10 ...	3¼
„ 24 ...	9 ...	10½			

March 13.—Left hospital for convalescent home. No change in physical signs since last note.

CASE 36.

Phthisis—Pleural Effusion—Paracentesis and subsequent formation of Empyema Necessitatis—Relief.

France Preston, ætat. 23, Blacksmith; admitted January 20, 1882; discharged April 14, 1882.

Family History.—Negative. Father and mother living and well. He has had no previous illness. Eight months ago he gave up working, as he was “not able to follow it up.” He then had slight cough, loss of appetite, and decrease in weight. Four months ago, the cough and spitting were much worse; he has been under different doctors, who told him he had bronchitis and diseased kidneys.

On examination, at the apex of the right lung, dulness and crackling crepitations were found, and signs of fluid at the left base, the dulness there reaching as high as one inch above the level of the angle of the scapula. The fluid was drawn off by the trocar, and a pint of opalescent sero-purulent fluid evacuated. He gradually improved, and on February 17, the note, “condition much improved—to get up,” was made.

March 22.—Right apex not so resonant as left, but the difference is much less marked than on his admission. On the right side, a few dry crackling râles are faintly heard with inspiration, above the second rib. Expiration prolonged, and in the third interspace cooing sounds are heard, with inspiration. Below this point respiration is normal. There are now signs of fluid from the eighth rib downwards, behind at the left base. He has gained eight pounds in weight, and the sputa are less abundant, and of more bronchial and less purulent nature; and cough is much less troublesome.

Treatment—

Cod Liver Oil.

Good diet and quinine.

Painting chest with iodine.

He was sent to the seaside; and on his return, an abscess, communicating with the interior of the chest, pointed posteriorly in eighth space, at site of paracentesis puncture.

CASE 37.

Copious Pleuritic Effusion—Paracentesis twice—Death.

Joseph Hirst, ætat. 41, Fire-tenter.

Family History.—Good, and he has been a steady man, and had no previous illness.

He has been ill three months, but came home ten weeks ago. The onset of the illness was gradual and painless. His chest was tapped ten weeks ago.

He is a thin man, of somewhat dusky countenance, and has the appearance of one very ill. He cannot lie upon the left side.

Chest.—Capacious. Bulging in outer aspect of right hypochondrium and intercostal spaces are obliterated at base. Expansion of right side very slight; but the whole respiratory act is performed in a jerky manner, and with effort.

The interval between each respiration is longer than normal.

In front—There is complete dulness, reaching from above the clavicle. No respiratory sounds audible, except close to clavicle, where a faint distant wheezing is heard, with some rhonchi. On left side, respiration sound is not increased.

Expiration is not audible, and there are no râles.

Behind—Right side absolutely dull, except over area close to spine, reaching as far as the fifth rib, and as far outwards as the base of the scapula. Breath-sounds here faintly audible.

Heart—Apex can be felt beating in left axilla, but is most distinct just below the nipple, five inches from mid-sternum. No bruit.

The liver reaches $1\frac{1}{2}$ inches below the umbilicus in the nipple line. It completely fills the umbilical region, and is perceptible at the border of the left hypochondrium.

Pulse 120 in lying position. Regular, but strength of beats very unequal. It is very small, and if irregular, would represent the pathognomic pulse of mitral disease. Respirations 32. No lividity of lips. Appetite, moderately good. Skin hot and acrid, and he sweats a good deal at night. Pupils dilated.

Urine scanty and loaded with lithates.

April 8.—Right chest tapped. Nine pints of dark-coloured clear fluid drawn off, which rapidly coagulated.

April 11.—Liver still to be felt at level of umbilicus. There is yet complete dulness in front of right chest.

Behind—there is improvement in percussion note, reaching to about the middle of the scapula from above, and in this area breath-sounds are faintly audible.

April 13.—Appears more comfortable. Face not so flushed and skin cooler. Pulse 138, stronger and beats more equable. Respirations 24. Move-

ments of right chest greater, but still much deficient, especially at the base.

In front—Breath-sounds are audible as low as third interspace, of moist character and resemble large crepitations. Right apex much more resonant, and as far as fourth rib there is gradually diminishing resonance; below which there is complete dulness.

Behind—There is comparative resonance as far as level of sixth rib, and over this space breath-sounds can be faintly heard, less coarse and moist, and more breezy and natural than in front. Below this there is absolute dulness and loss of breath-sounds.

April 18.—Patient died. Hæmaturia before death.

CASE 38.

George Bottomley, ætat. 36, Upholsterer; admitted into Huddersfield Infirmary, May 3, 1883, after a local surgeon had inserted a hollow needle behind the right axillary line, and drawn away "one pint and a few gills" of bloody fluid. On taking out the needle, which was a very fine one, it broke, leaving about $1\frac{1}{2}$ inches in the patient's body. Chloroform was at once administered, and an exploratory incision made to search for the fragment; but with negative result. The needle was not found, and the patient did not complain of any inconvenience, and was discharged well with the needle in his chest.

This patient has since died.

The notes of the cases recorded above having been transcribed literally, apology for grammatical errors must be made.

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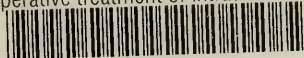
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The operative treatment of intrathoracic



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